EarthComm®

Earth's Dynamic Geosphere

Chapter 1: Volcanoes...and Your Community

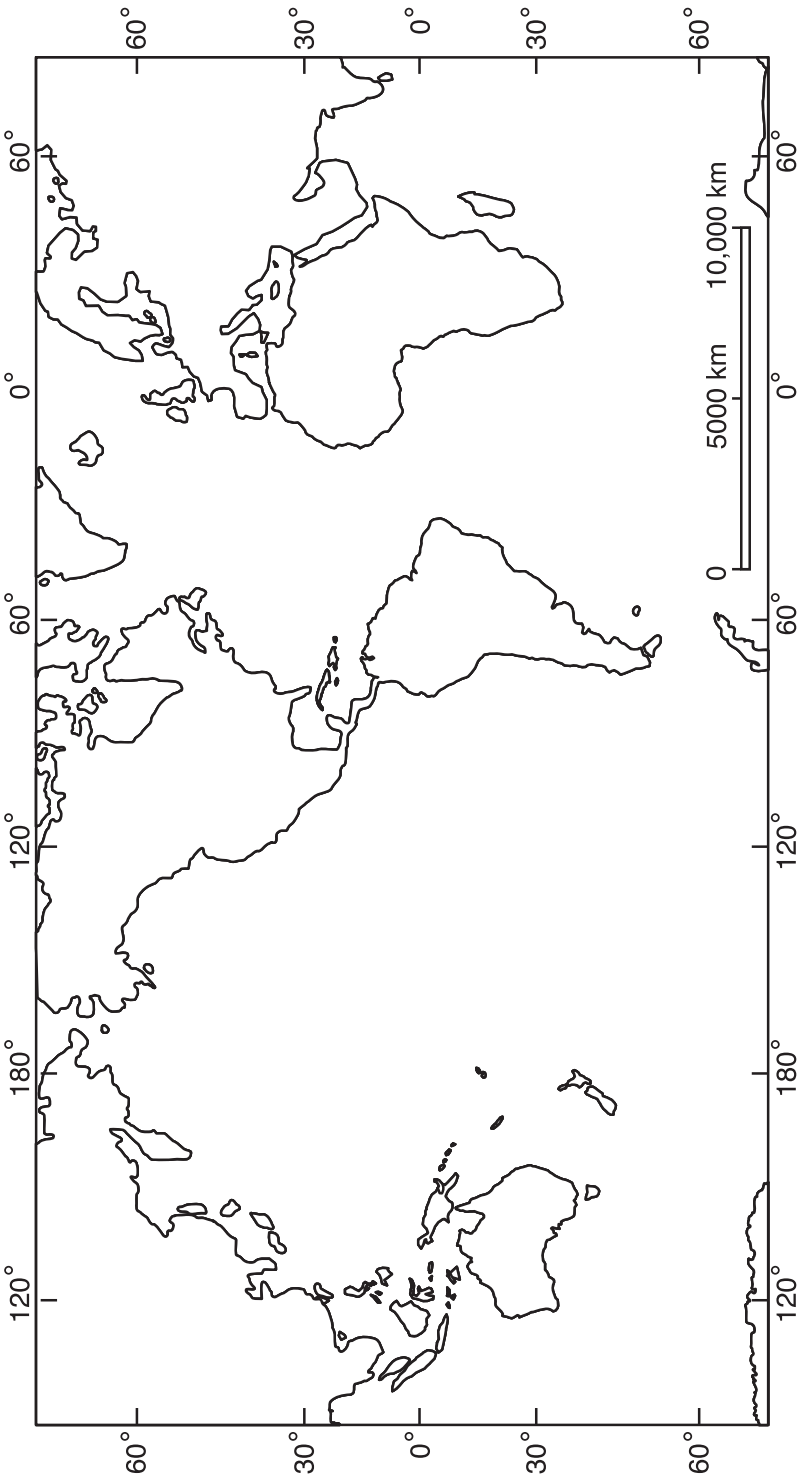
Chapter 2: Plate Tectonics...and Your Community

Chapter 3: Earthquakes...and Your Community

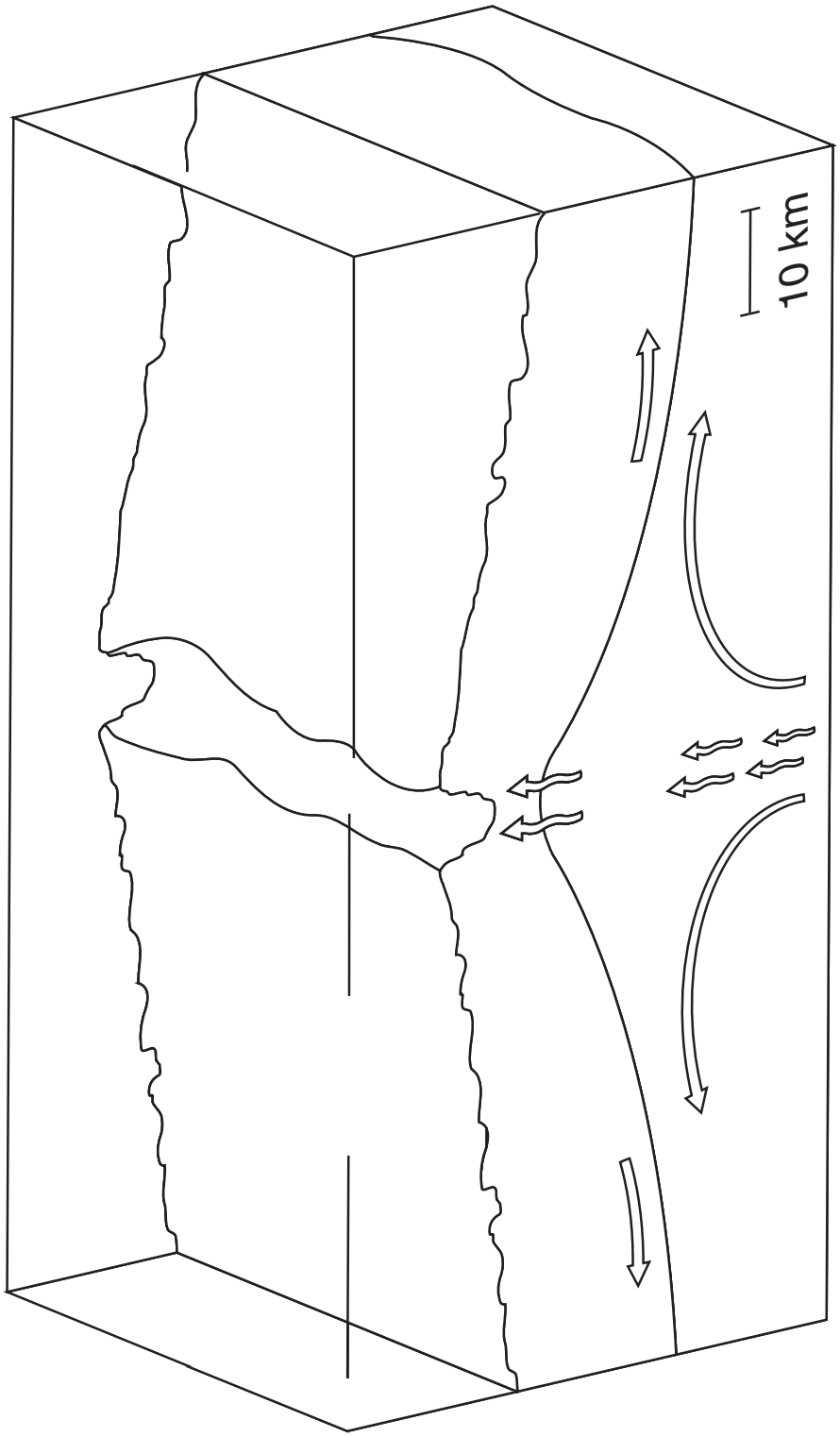
Earth's Dynamic Geosphere

Chapter 1
Volcanoes...and Your Community

Blackline Master 1.1
Blank World Map



Blackline Master 1.2
Cross Section Through a Mid-Ocean Ridge

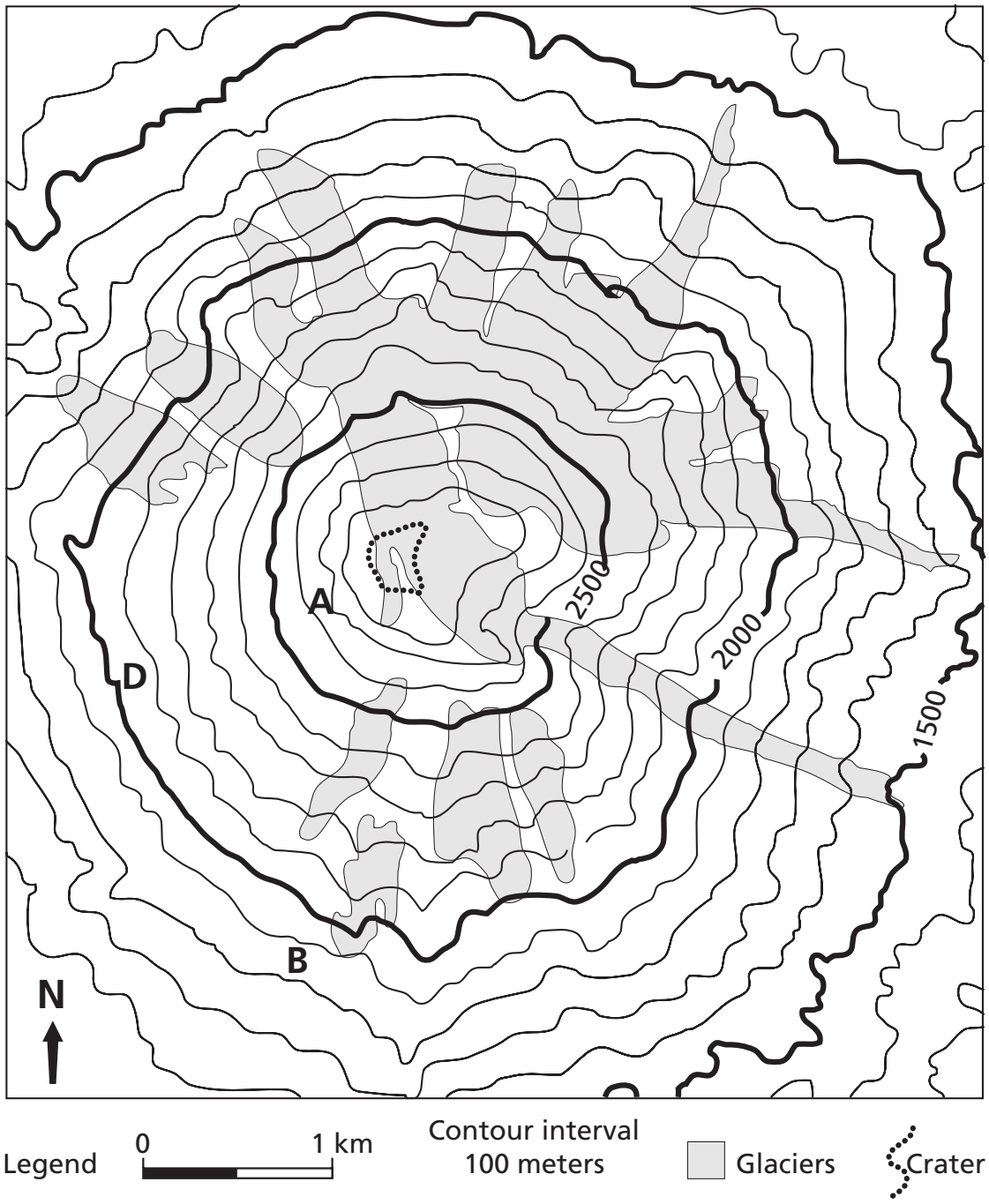


Assessment Rubric: Preparing for the Chapter Challenge

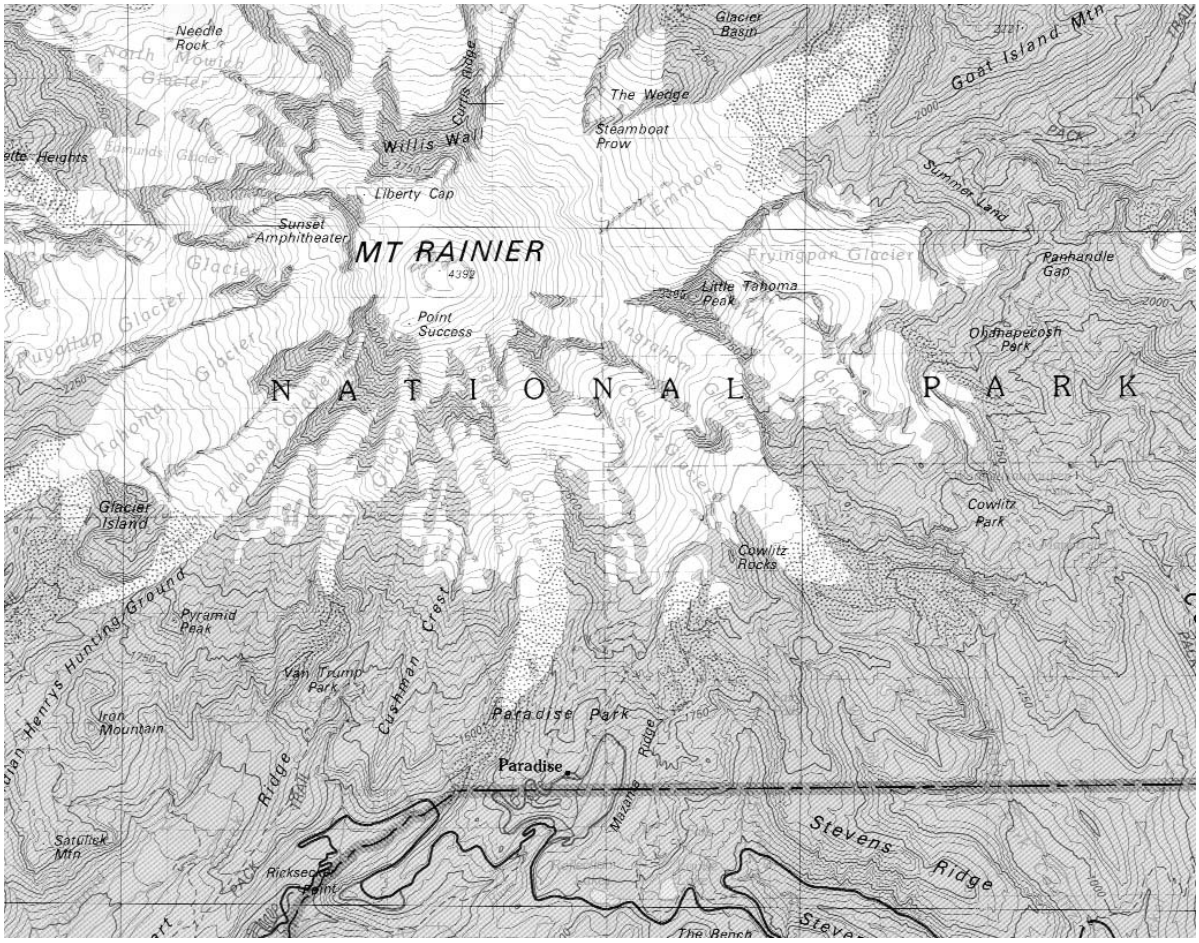
Item and Value	Missing	Incomplete/ Inaccurate	Complete/ Accurate
Essay			
Explains the map they have made.			
Notes the locations of volcanoes closest to their community.			
Explains where most volcanoes occur in the United States.			
Notes regions in the United States where volcanoes have not occurred lately.			
Map			
Shows thick lines where volcanoes occur along a linear pattern.			
Shows thin lines for the volcanism at spreading plate boundaries (mid-ocean ridge system).			
Outlines regions where volcanoes are less concentrated.			
Map includes a key or legend.			
Subtotals			

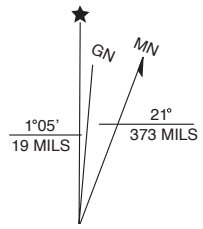
Total Score	

Blackline Master 2.1
Map of Mt. St. Helens



Blackline Master 2.2
Topographic Map of Mt. Rainier





UTM GRID AND 1978 MAGNETIC NORTH
DECLINATION AT CENTER OF MAP

SCALE 1:100,000

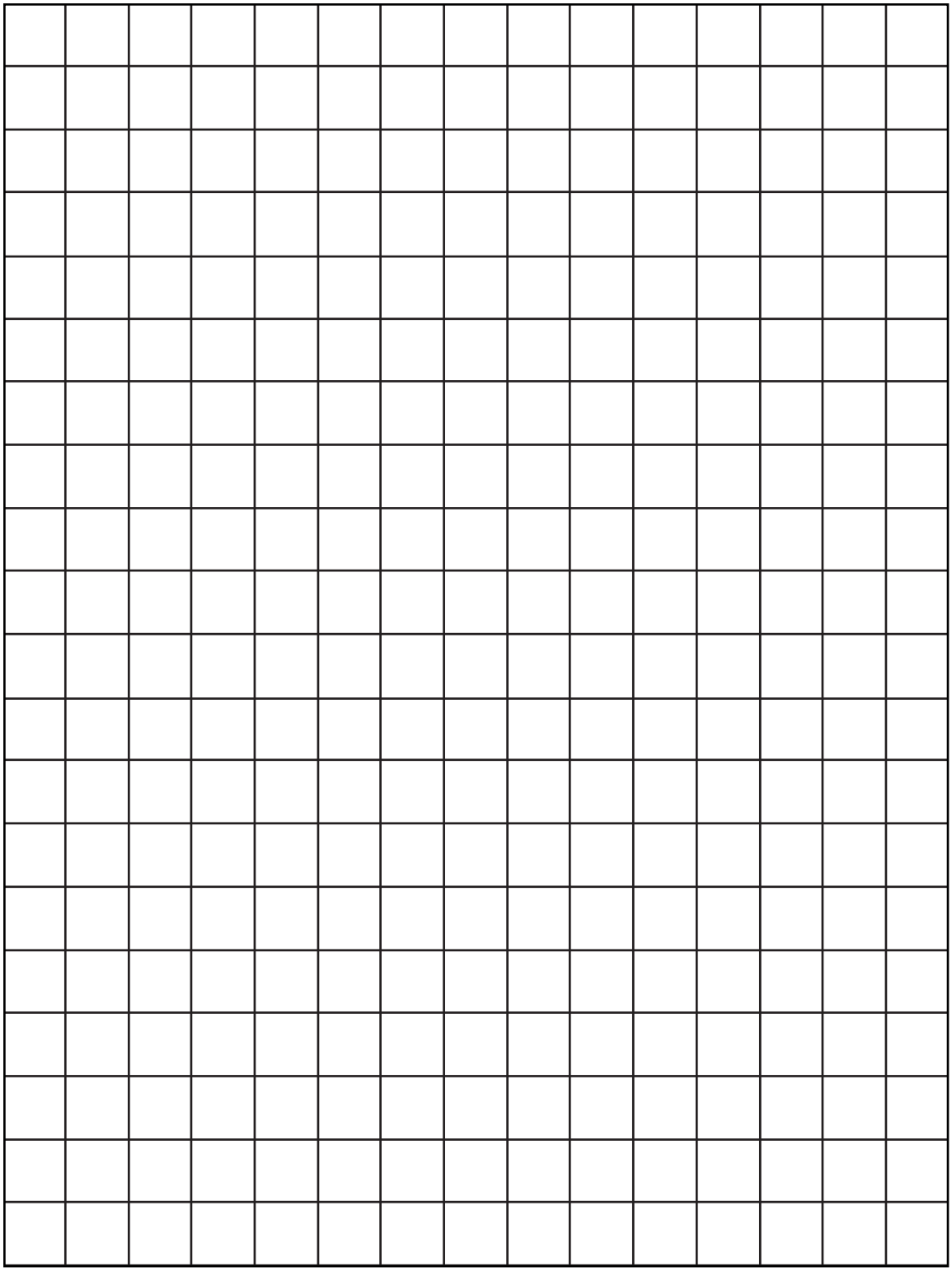
1 0 1 2 3 4 5 6 7 8 9 10
KILOMETERS

1 0 1 2 3 4 5
MILES

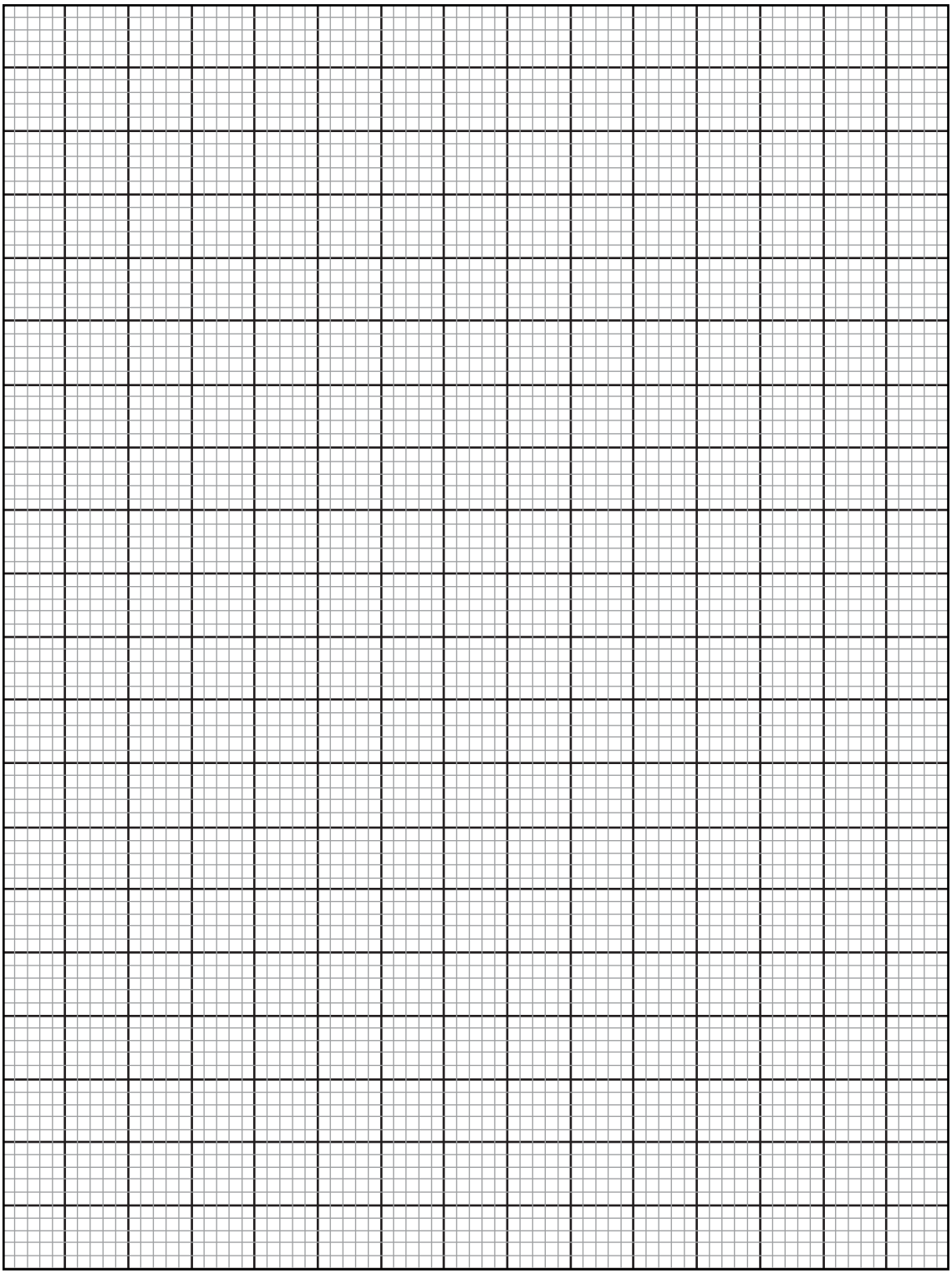
5000 0 5000 10000 15000 20000 25000
FEET

CONTOUR INTERVAL 50 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
To convert meters to feet multiply by 3.2808
To convert feet to meters multiply by 0.3048

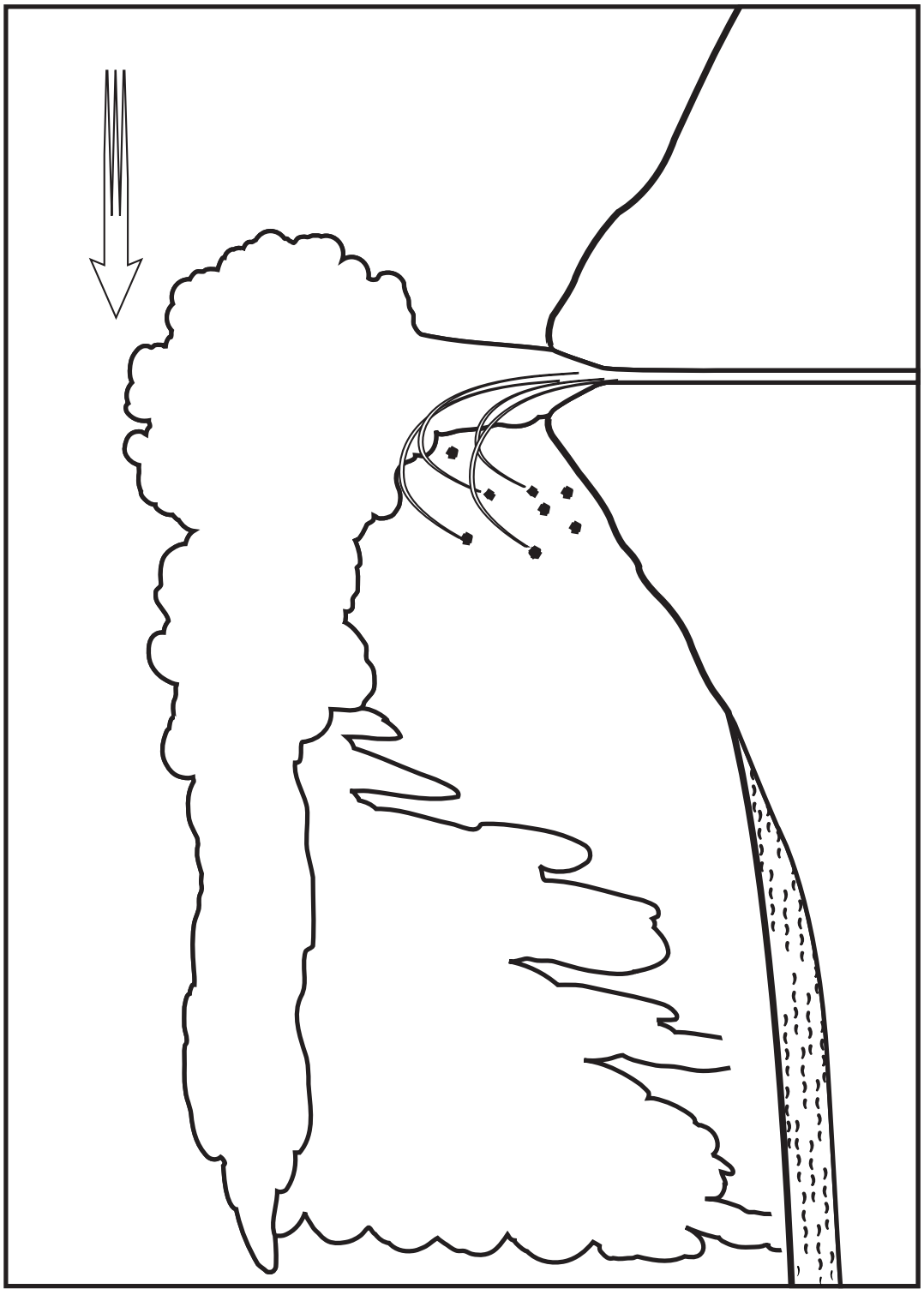
Blackline Master 3.1
Square Centimeter Graph Paper



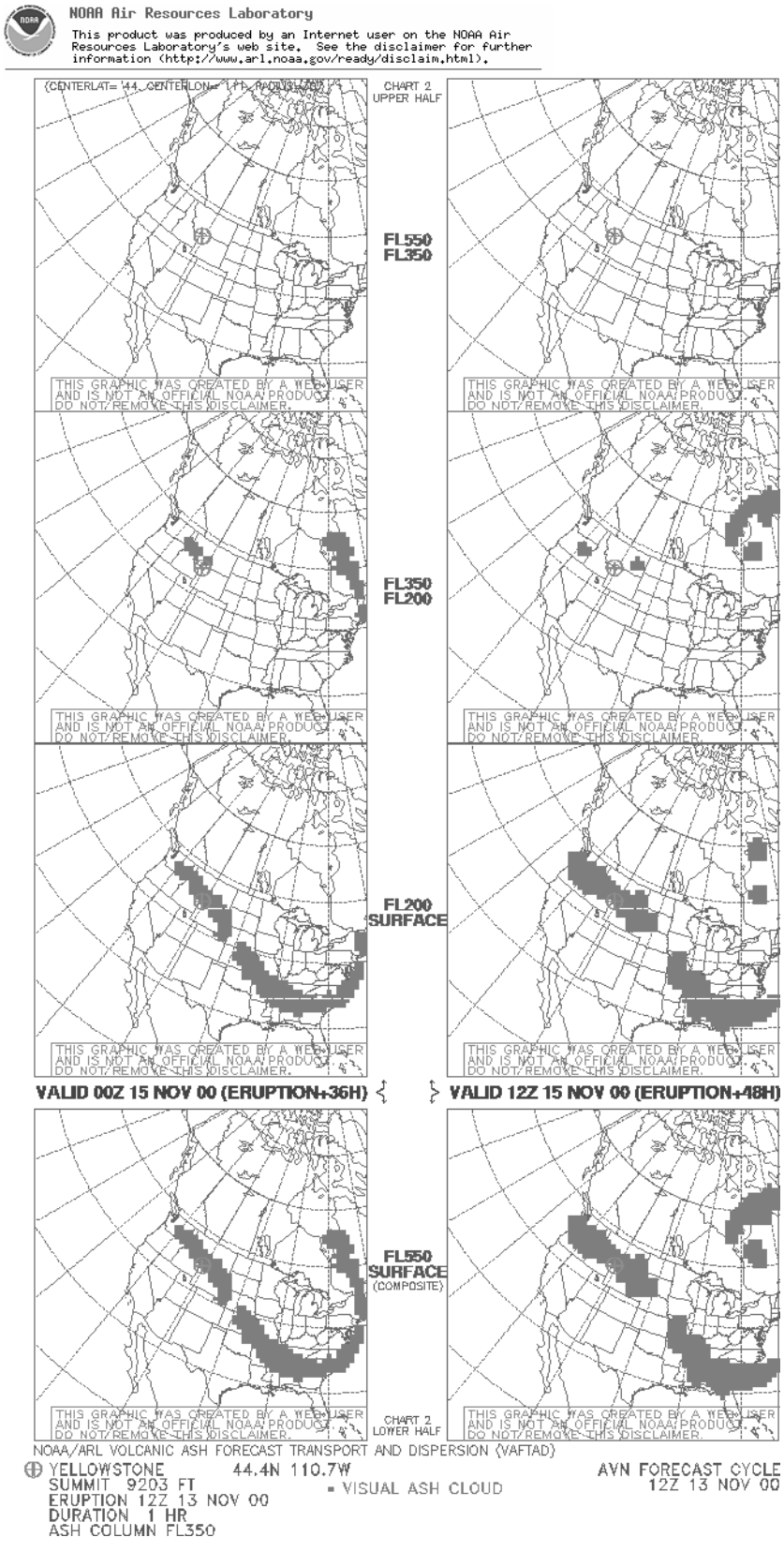
Blackline Master 4.1
Graph Paper



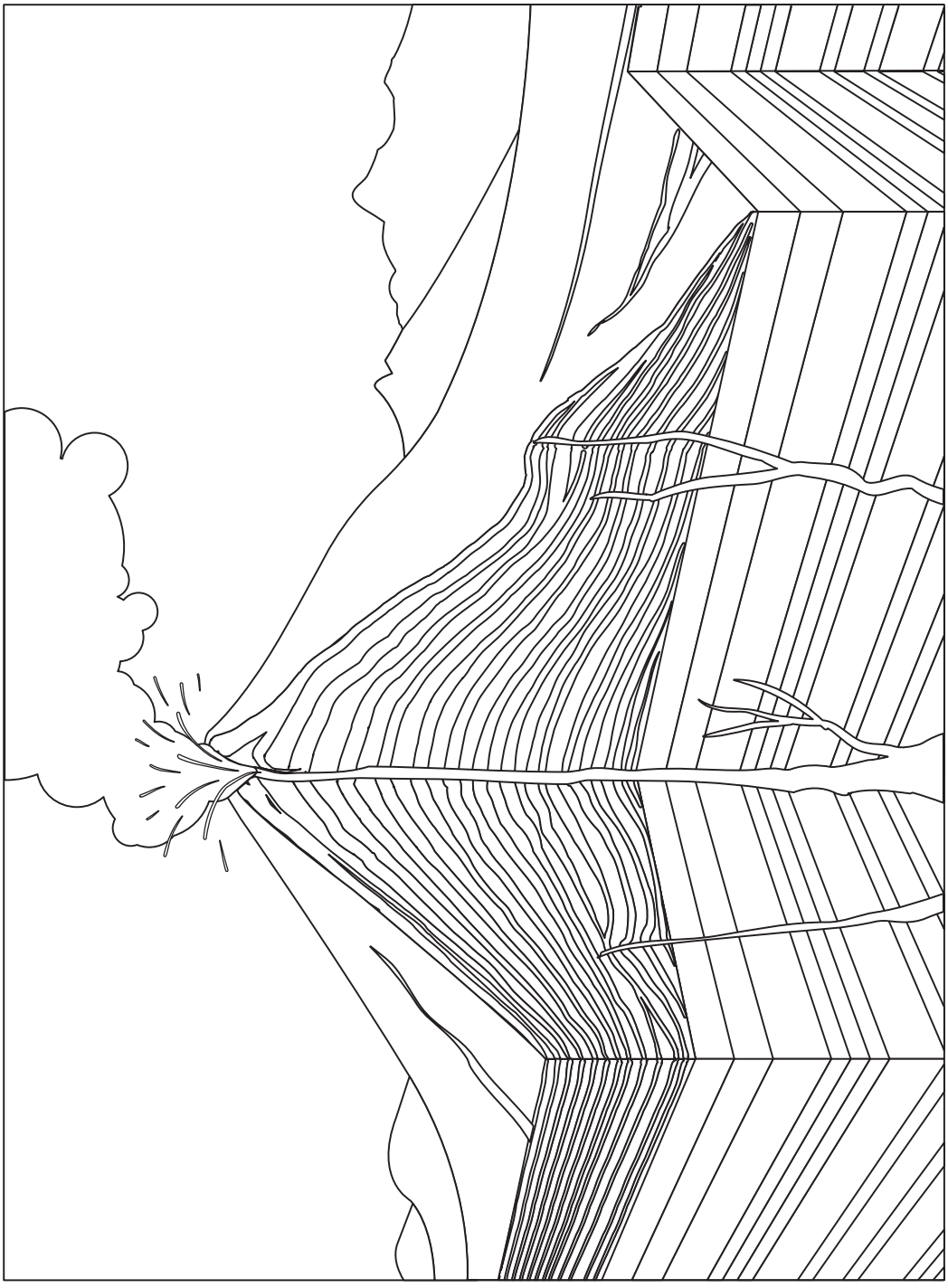
Blackline Master 4.2
Airborne Releases from Volcanic Eruptions



Blackline Master 4.3
Volcanic Ash Fallout Movement



Blackline Master 6.1
Cross Section of a Composite Volcano



Blackline Master 6.2
Major Rock Types and Examples

Rock Types and Examples			
Intrusive Igneous Rocks	**Extrusive Igneous (Volcanic) Rocks**	**Sedimentary Rocks**	**Metamorphic Rocks**
anorthosite	aa	arkose	amphibolite
diorite	agglomerate	breccia	gneiss
dolerite	basalt	calcarenite	graphite
dunite	andesite	calcirudite	greenstone
gabbro	basalt	calcisiltite	hornfels
granite	crystal tuff	chalk	marble
granodiorite	dacite	chert	metaconglomerate
granophyre	ignimbrite	claystone	metasediment
kimberlite	latite	coal	phyllite
lamprophyre	lithic tuff	conglomerate	quartzite
larvikite	obsidian	coquina	schist
leucogabbro	pahoehoe	dolostone	serpentinite
nepheline	pumice	graywacke	skarn
norite	ropy lava	limestone	slate
pegmatite	rhyolite	lithic sandstone	soapstone
peridotite	scoria	micrite	
porphyry	spilite	mudstone	
pyroxenite	trachyte	oolitic limestone	
syenite	tuff	peat	
trachyte	vesicular basalt	rock gypsum	
troctolite	welded tuff	rock salt	
		sandstone	
		shale	
		siltstone	

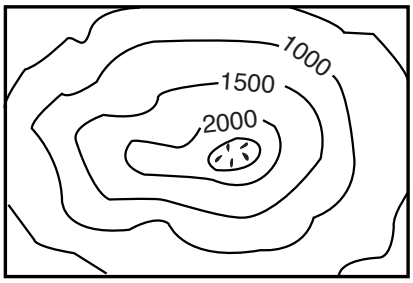
Volcanoes and Your Community: End-of-Chapter Assessment

1. Which of the following best describes the global distribution of volcanoes?
   a) Most volcanoes occur in linear patterns.
   b) Most volcanoes occur at the Earth's poles.
   c) Most volcanoes occur on land.
   d) Most volcanoes occur in coastal California.

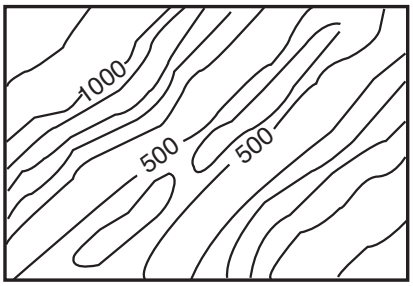
2. At which of the following locations would you LEAST expect volcanic activity?
   a) Iceland.
   b) Washington and Oregon.
   c) Central Ohio.
   d) The middle of the Atlantic Ocean.

3. Which of the following topographic maps represents a classic volcanic cone?
   a) A
   b) B
   c) C

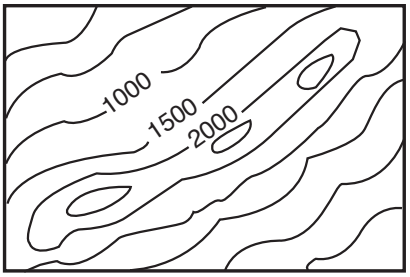
(A)



(B)



(C)



4. Which of the following is most likely to erupt explosively?
   a) Magma of very low silica content (40%).
   b) Magma of low silica content (50%).
   c) Magma of medium silica content (60%).
   d) Magma of high silica content (70%).

5. Which of the following results from volcanic eruptions onto mountainsides covered with snow and ice?
    a) Cinder cones formed of pyroclastic debris.
    b) Damaging mudflows of wet volcanic debris called lahars.
    c) Lava domes of thick, viscous magma.
    d) Giant calderas that can be many kilometers in diameter.

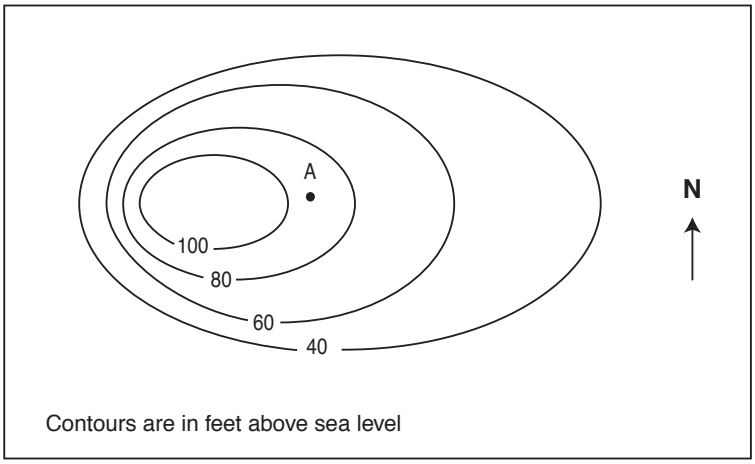
6. Which of the following volcanic hazards is most likely to affect communities several hundred kilometers from the volcano site?
    a) Mudflow.
    b) Ash fall.
    c) Pyroclastic flow.
    d) Lava flow.

7. On a walk in your community, you find rock exposures of fine-grained basalt and pumice. What can you infer about volcanic activity in your community from the presence of these rocks?
    a) Volcanic activity will occur in your community in the near future.
    b) There has once been volcanic activity in your community.
    c) Basalt and pumice once erupted at the same time in your community.
    d) Igneous rocks formed underground in your community and are now exposed due to erosion.

8. Which of the following is NOT a role that volcanoes play in the water cycle and atmosphere?
    a) Volcanoes emit water vapor into the atmosphere.
    b) Groundwater circulates within volcanoes and near other hot rock bodies and becomes heated.
    c) Mudflows associated with volcanoes (lahars) contain water brought from the interior of the Earth (mantle).
    d) All of the oxygen in the air we breathe originally came from a volcano.

9. Mercator map projections, such as the map *This Dynamic Planet:*
    a) Distort regions more and more as you move toward the poles.
    b) Accurately represent the size and shape of the United States.
    c) Are most distorted near the Equator.
    d) Cover the entire Earth.

Questions 10 through 12 refer to the map below.



10. What is the contour interval?
    a) 20 feet.
    b) 40 feet.
    c) 60 feet.
    d) 80 feet.

11. If lava erupted at point A, in which direction would it flow?
    a) North
    b) South
    c) East
    d) West

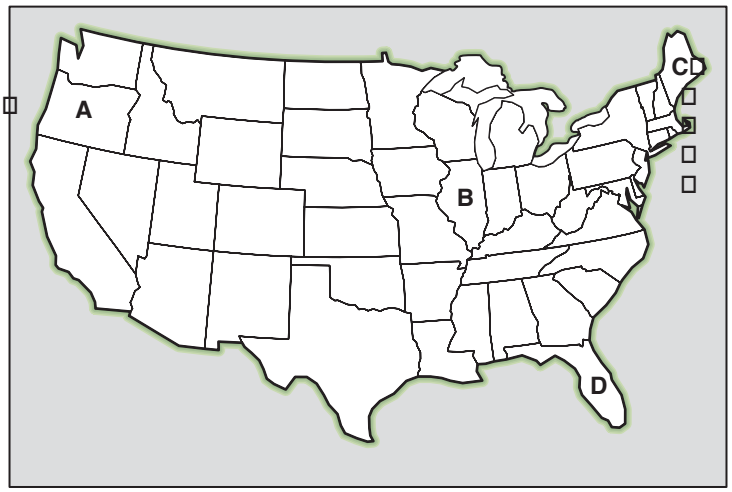
12. Which side of this feature has the steepest slope?
    a) North
    b) South
    c) East
    d) West

13. Which of the following would increase the speed of flow of magma?
    a) An increase in viscosity.
    b) An increase in silica content.
    c) A decrease in slope.
    d) An increase in temperature.

14. If magma from a volcanic eruption were low in silica and low in gas content, which hazard would you expect?
    a) Tephra fallout.
    b) Ash fallout.
    c) Lava flow.
    d) Pyroclastic flow.

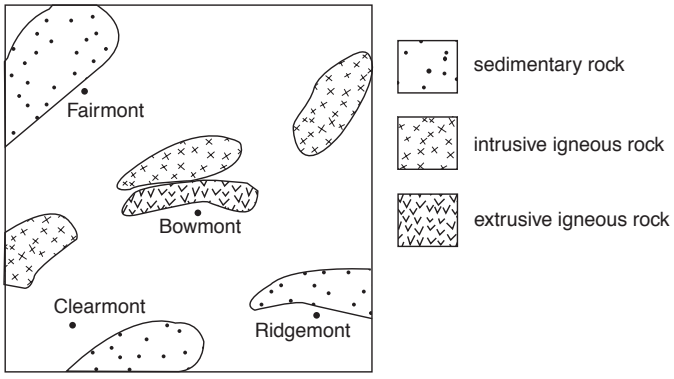
15. Which of the following would be the best predictor of local wind direction?
    a) Ash fallout.
    b) Low Volcanic Explosivity Index (VEI).
    c) High Volcanic Explosivity Index (VEI).
    d) Lahar path.

Question 16 refers to the map below.



16. What is the most likely location of a new volcano?
    a) A
    b) B
    c) C
    d) D

Question 17 refers to the map below.



17. Using the map data, infer which town is located closest to a volcanic area.
    a) Fairmont.
    b) Clearmont.
    c) Ridgemont.
    d) Bowmont.

18. Which of the following describes an extrusive igneous rock?
    a) Slowly cooled rock with coarse grains.
    b) Quickly cooled rock with coarse grains.
    c) Slowly cooled rock with fine grains.
    d) Quickly cooled rock with fine grains.

19. When magma from beneath the Earth's surface erupts as a volcano, which of the following happens?
    a) The amount of gas dissolved in the magma increases.
    b) The pressure on the magma increases.
    c) The amount of gas dissolved in the magma decreases.
    d) The amount of water vapor in the air decreases.

20. Which of the following statements is the most accurate?
    a) Volcanic eruptions lead to global cooling.
    b) Volcanic eruptions only lead to global warming.
    c) Some volcanic products affect global cooling; others affect global warming.
    d) Volcanic eruptions always lead to increased rainfall.

21. Which of the following changes are most likely to occur prior to an eruption?
    a) An increase in the number of earthquakes and decrease in the amount of steam escaping.
    b) An increase in the number of earthquakes and increase in the elevation of the land.
    c) A decrease in the number of earthquakes and increase in the amount of steam escaping.
    d) A decrease in the number of earthquakes and decrease in the elevation of the land.

22. Volcano monitoring can:
    a) Divert lava flows during a volcanic eruption.
    b) Slow a volcanic eruption.
    c) Reduce earthquakes in a volcanic eruption.
    d) Save lives in a volcanic eruption.

Volcanoes and Your Community: End-of-Chapter Assessment Answers

Answer Key

1. a
2. c
3. A
4. d
5. b
6. b
7. b
8. d
9. a
10. a
11. c
12. d
13. d
14. c
15. a
16. A
17. d
18. d
19. c
20. c
21. b
22. d

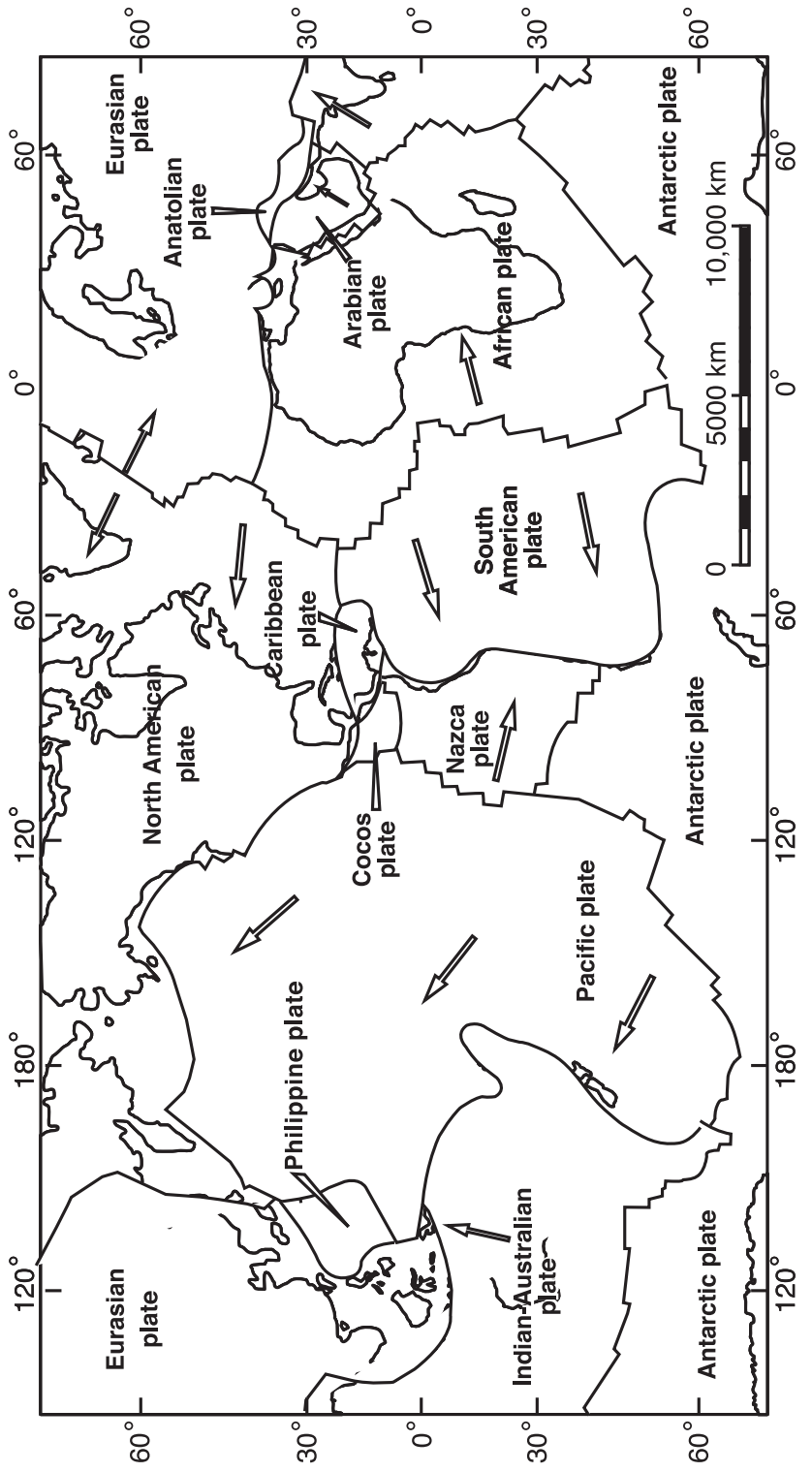
Volcanoes and Your Community: Classroom Resources

For a list of books, magazines, curriculum resources, web sites for teachers and students, videos, sources for materials listed in activities and optional materials consult the *EarthComm* web site.

Earth's Dynamic Geosphere

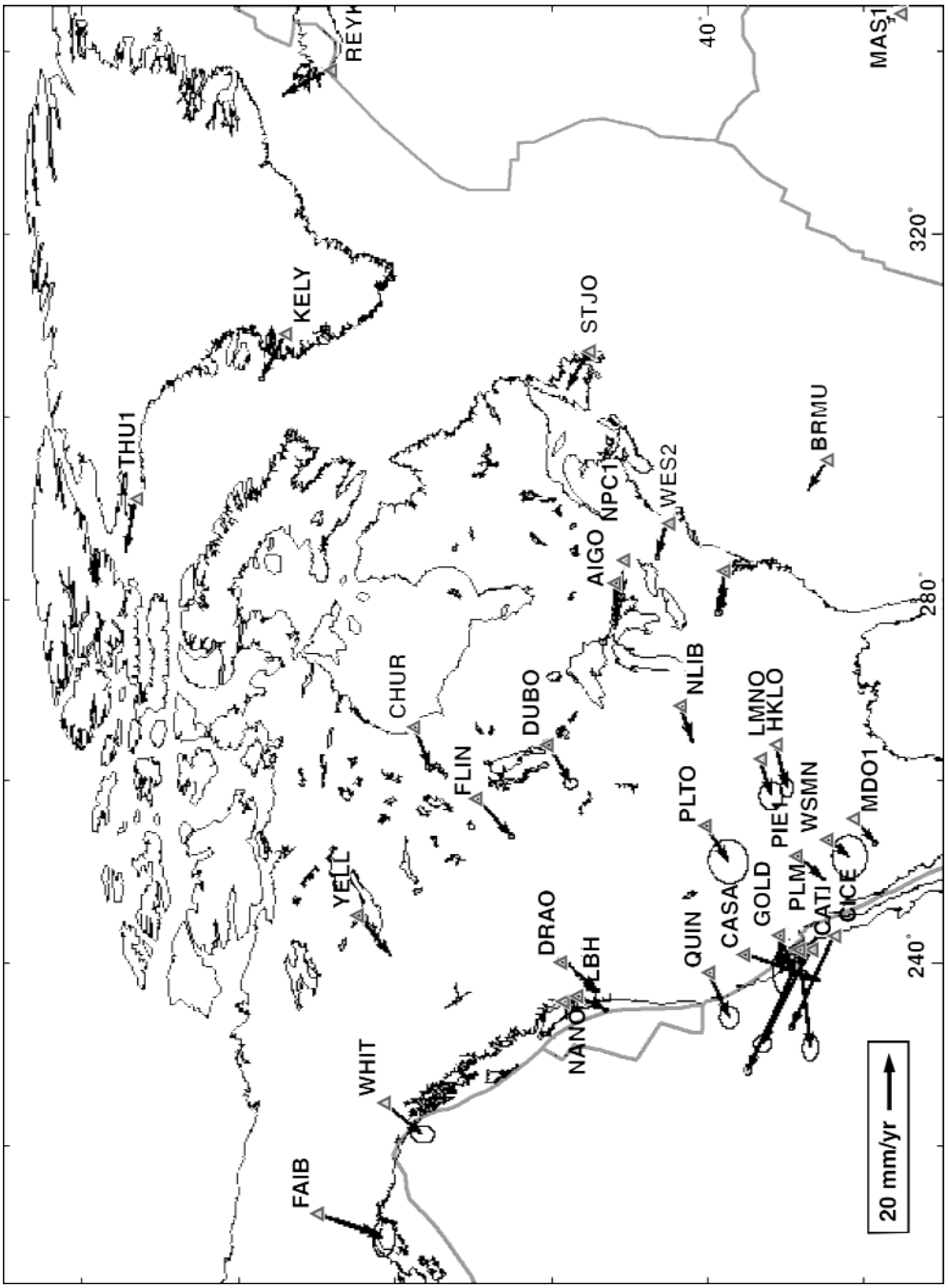
Chapter 2
Plate Tectonics...and Your Community

Blackline Master 1.1
World Map of Major Lithospheric Plates



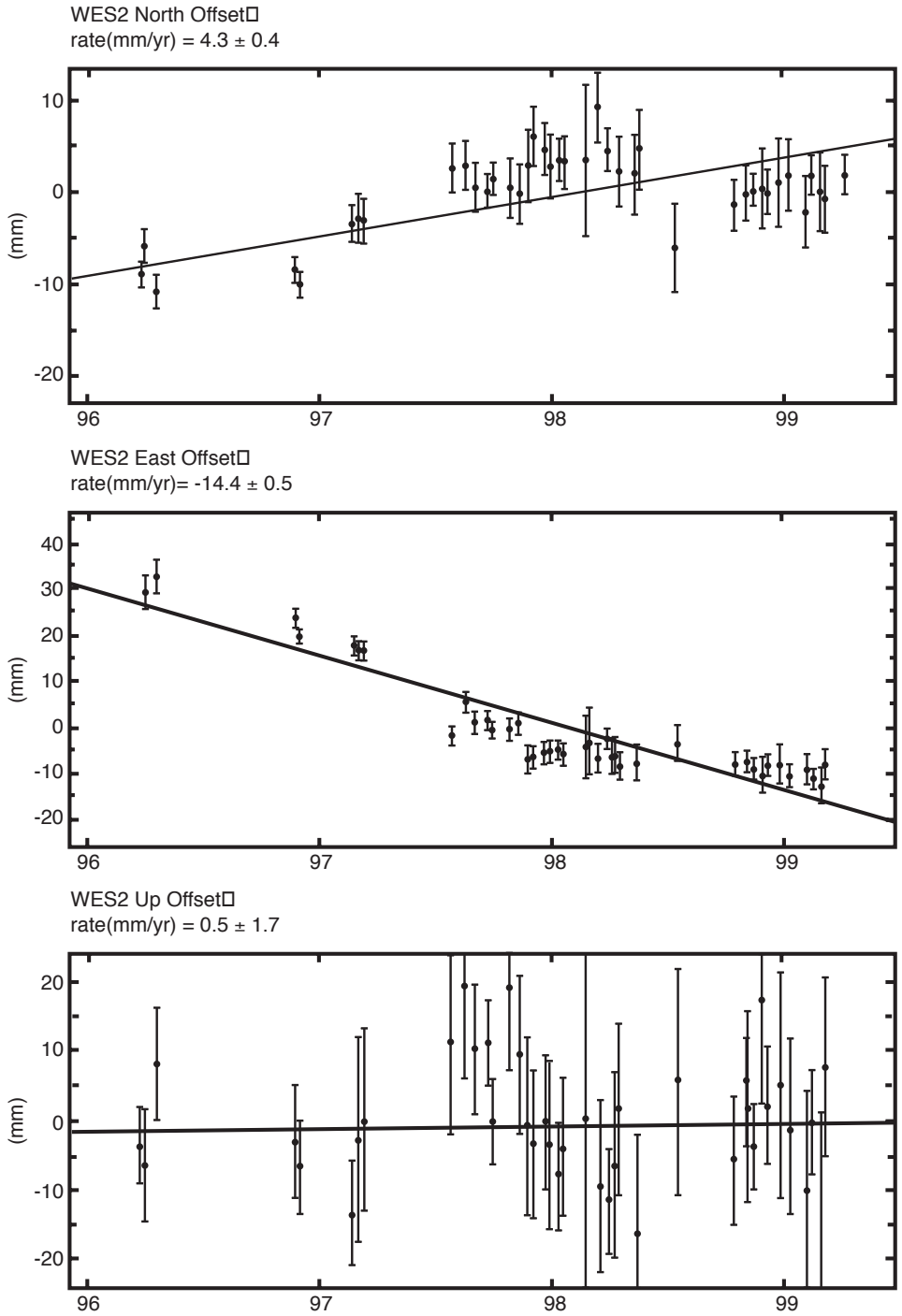
Blackline Master 1.2

Measurement of Movements at GPS Stations in North America

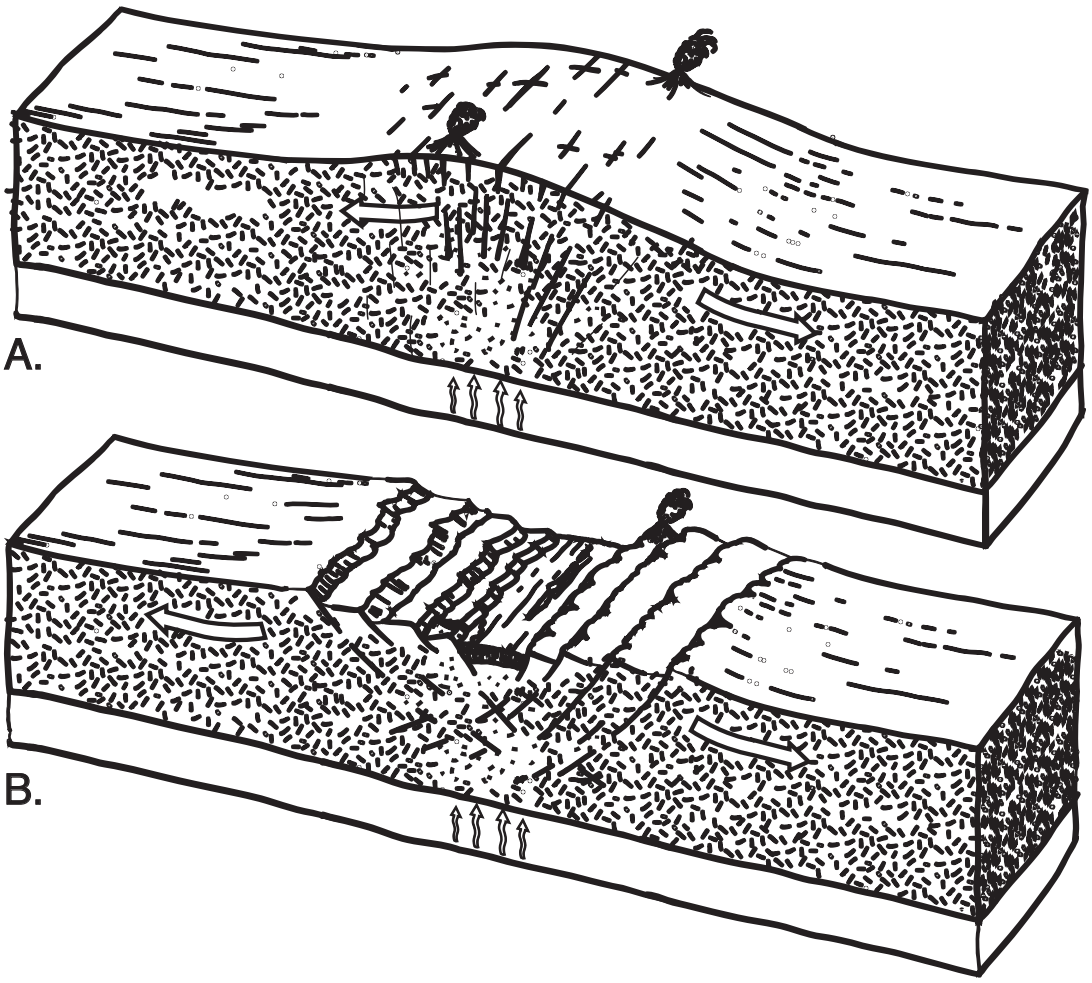


Blackline Master 1.3

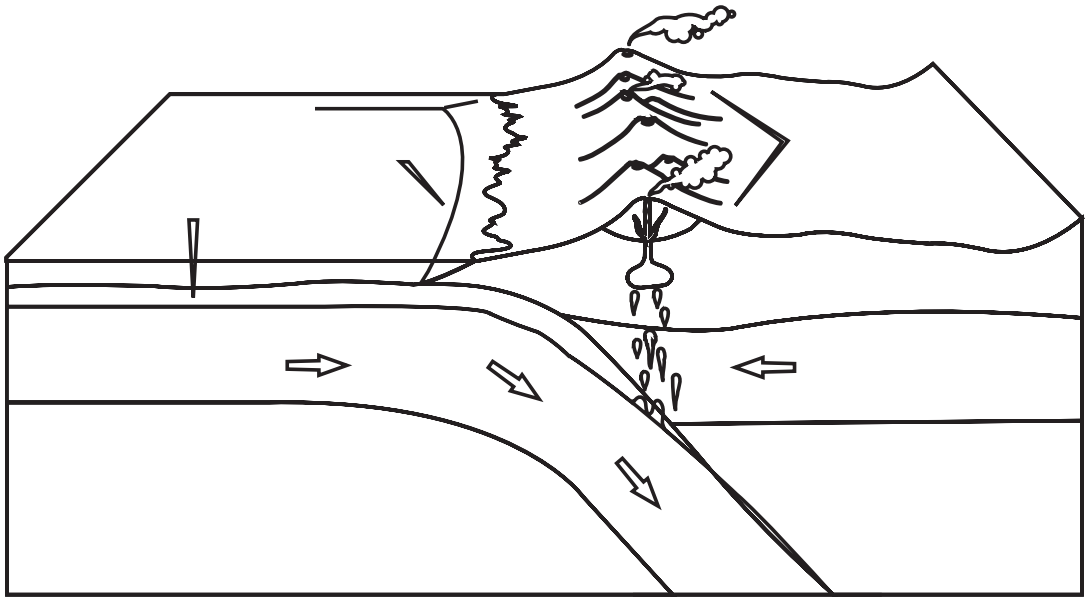
The Location and Elevation of GPS Station WES2 Over Time



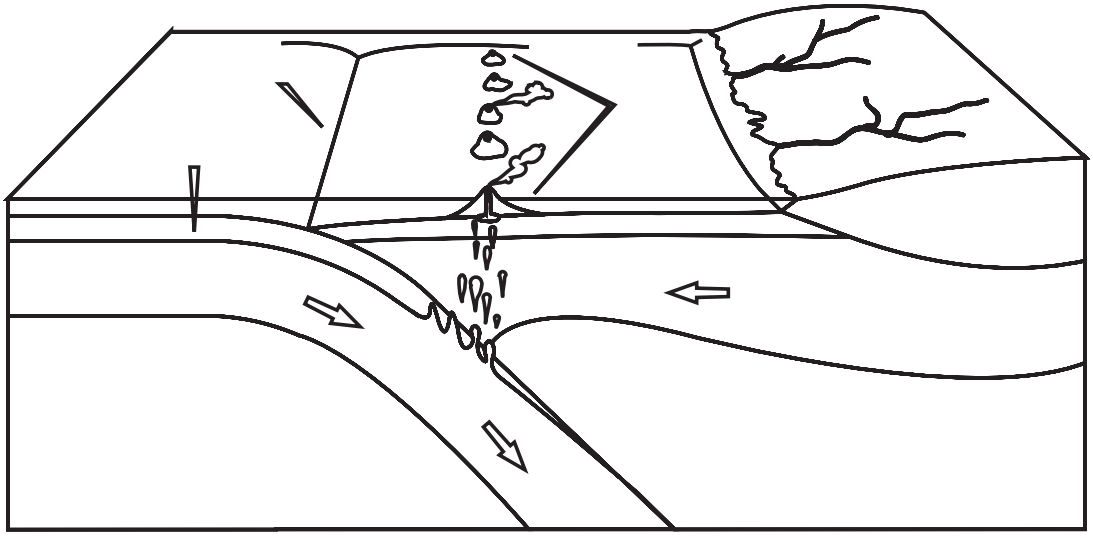
Blackline Master 2.1
Formation of a Rift Valley



Blackline Master 2.2
Cross Sections Through Subduction Zones

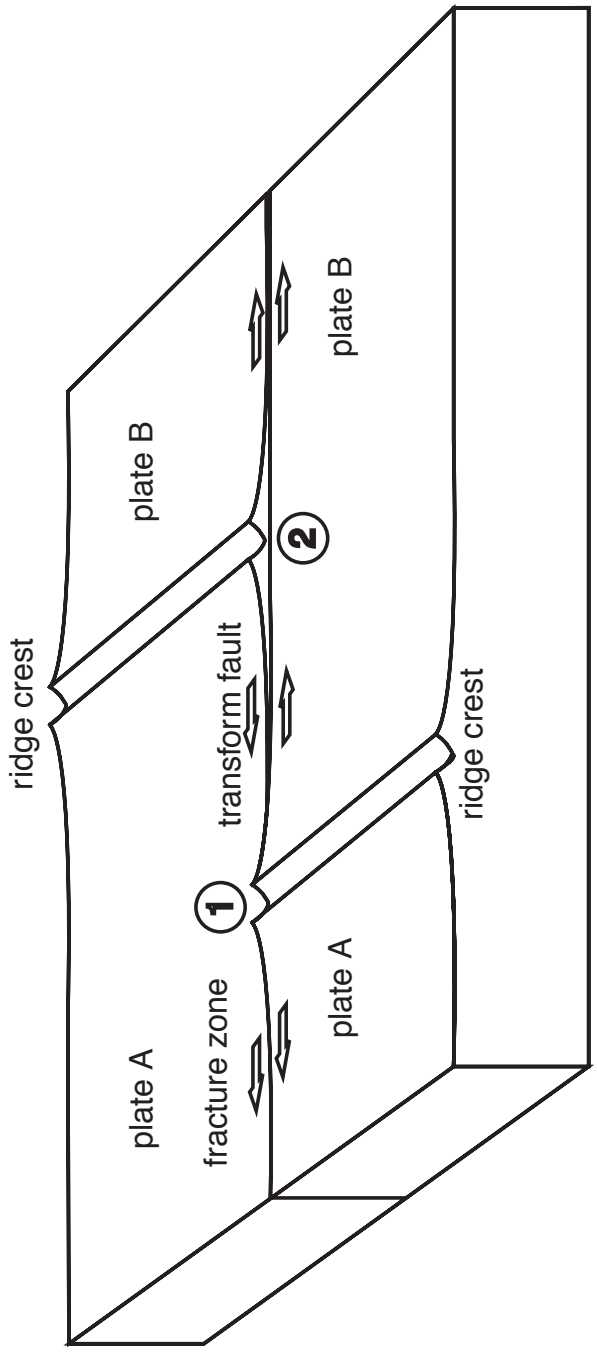


ocean–continent subduction

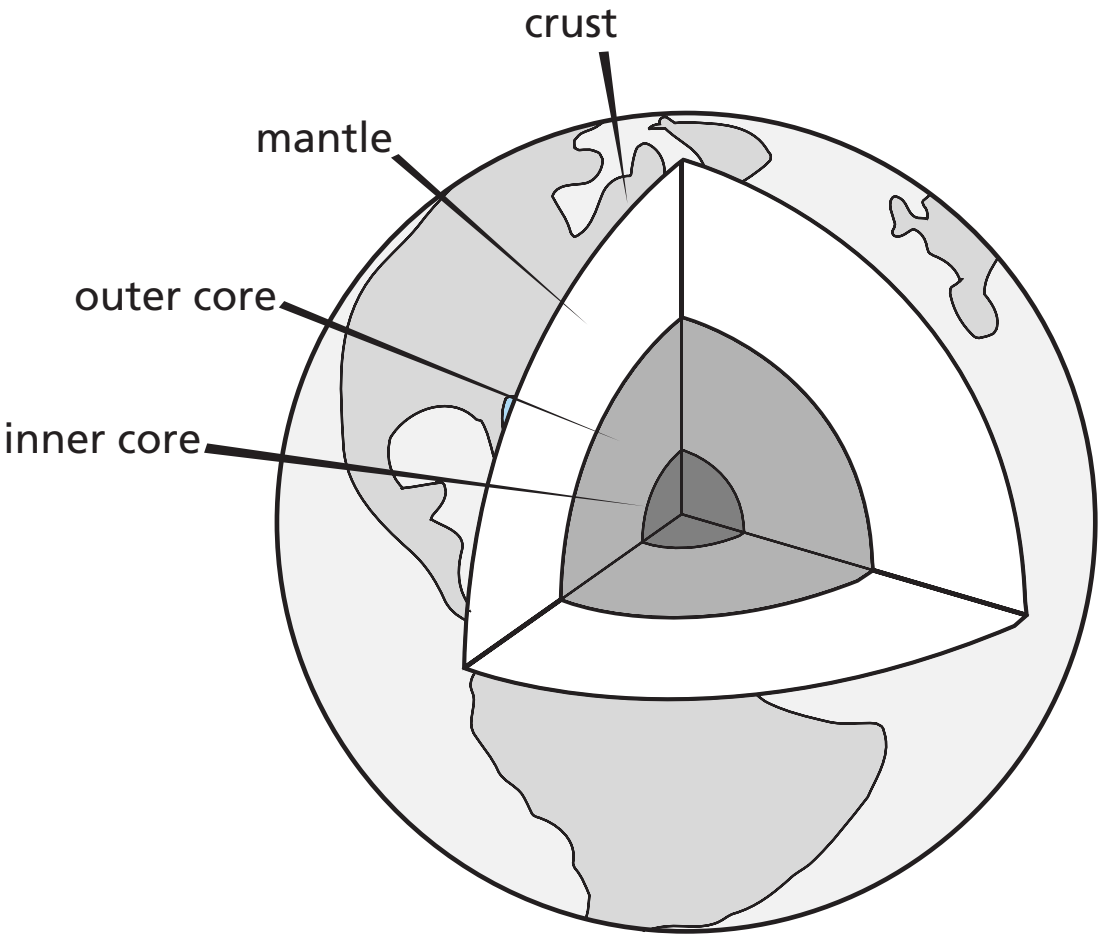


ocean–ocean subduction

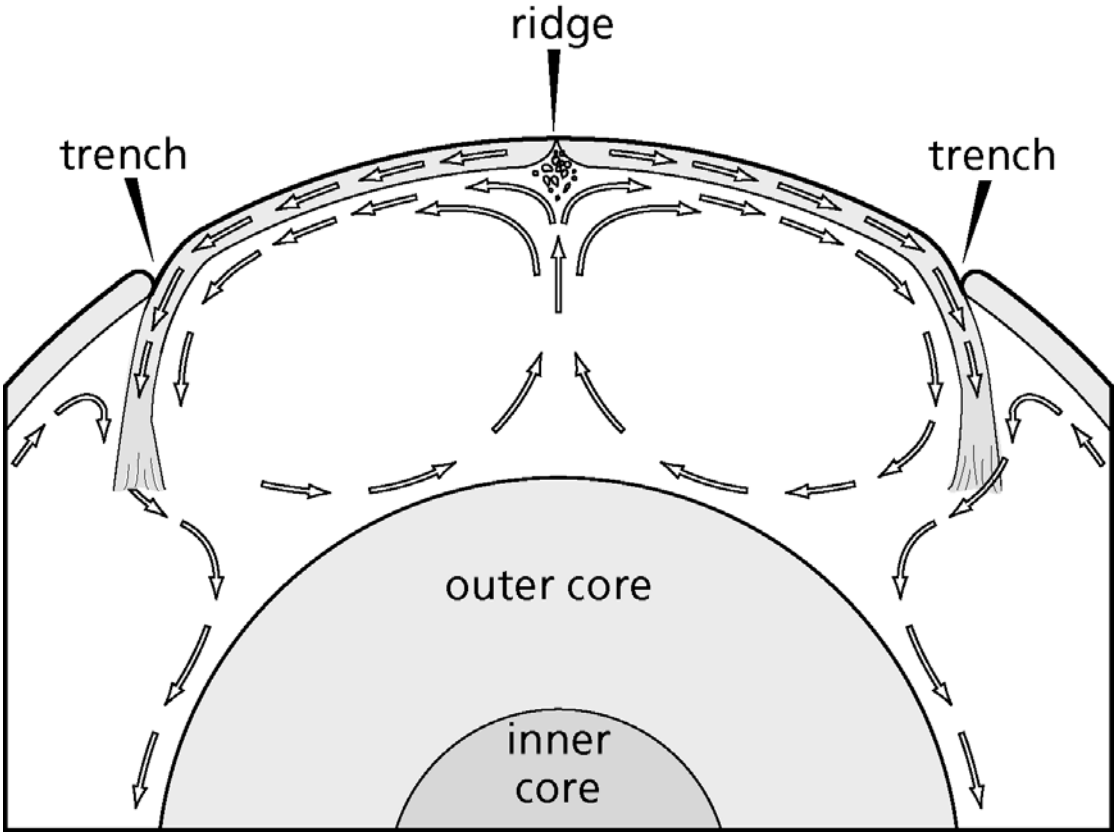
Blackline Master 2.3
Sketch Map of a Mid-Ocean Ridge



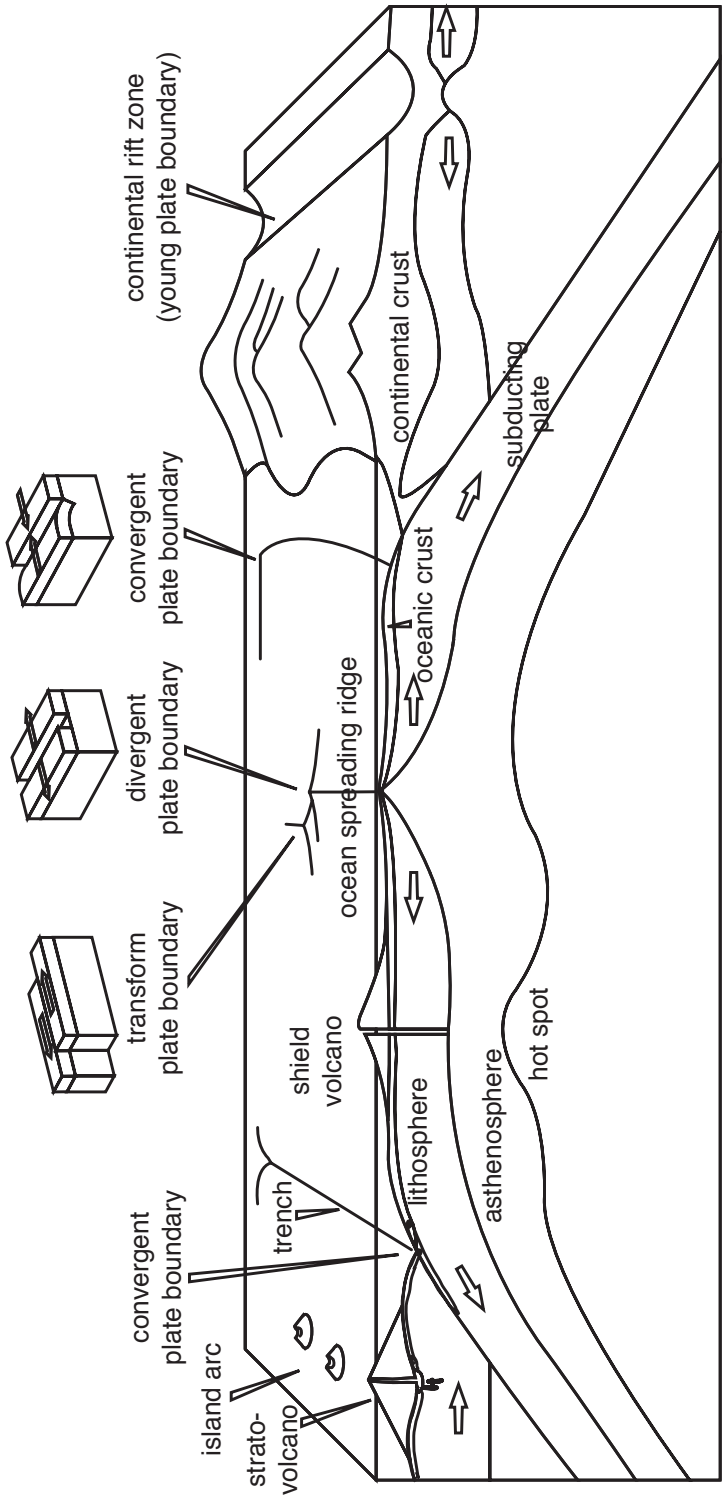
Blackline Master 3.1
Layered Structure of the Earth's Interior



Blackline Master 3.2
Pattern of Thermal Convection



Blackline Master 4.1
Cross Section With Two Subduction Zones

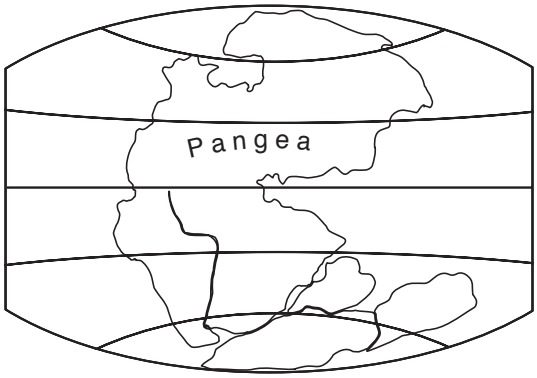


Blackline Master 5.1
Outline of the Continents

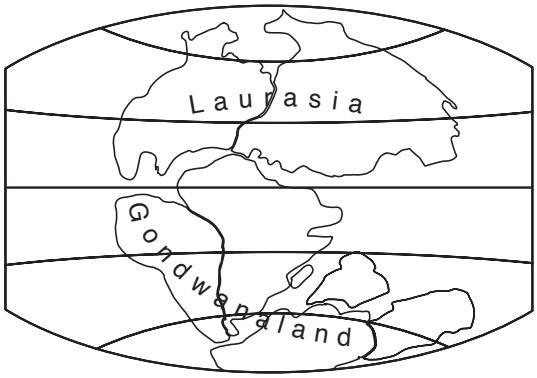
Legend

Fossil	Rock and mineral deposits	
Mesosaurus fossils	Ⓒ Coal	◇1 ◇2 ◇3 ◇4 ◇5 Mountain belts older than 250 million years
Cynognathus fossils	Ⓢ Salt	
Lystrosaurus fossils	Ⓖ Gypsum	
Glossopteris fossils	Ⓛ Desert sandstone	
	Ⓓ Glacial	

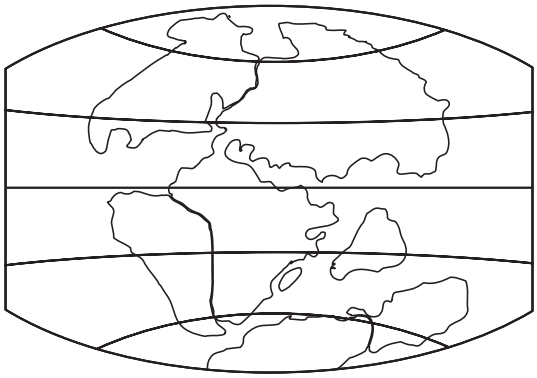
Blackline Master 5.2
The Breakup of Pangea



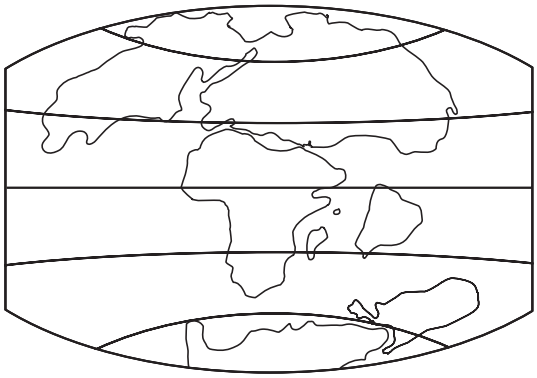
Permian
225 million years ago



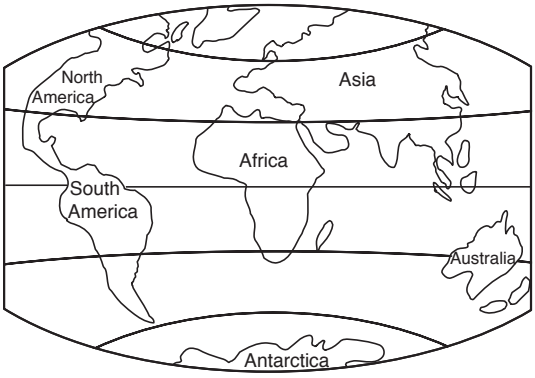
Triassic
200 million years ago



Jurassic
135 million years ago



Cretaceous
65 million years ago



Present Day

Plate Tectonics and Your Community: End-of-Chapter Assessment

1. The outermost, rigid layer of the Earth, consisting of the Earth's crust and part of the upper mantle, is the _____.
    a) biosphere
    b) lithosphere
    c) atmosphere
    d) asthenosphere

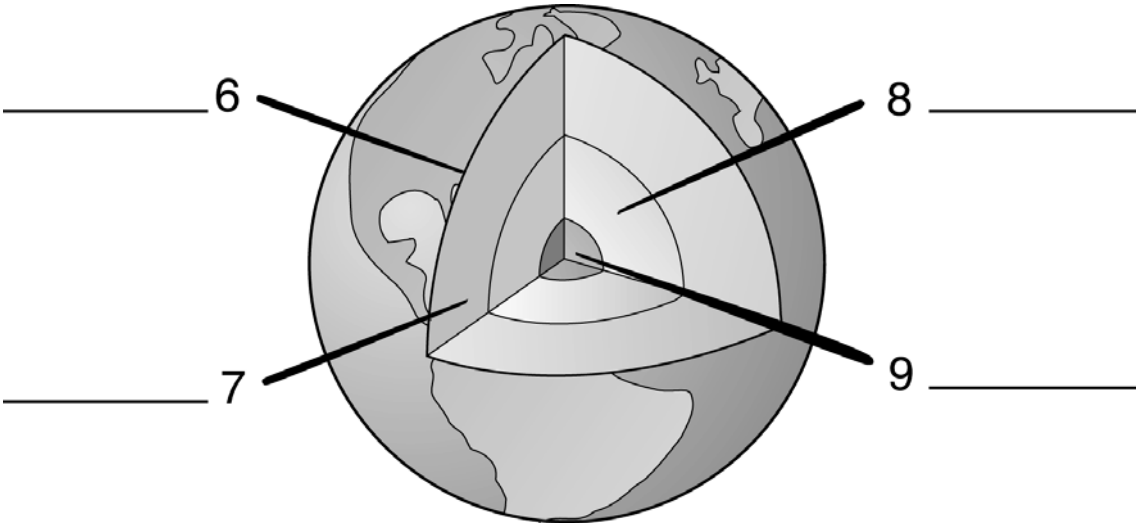
2. With few exceptions, increasing the temperature of a material will cause its density to _____.
    a) increase
    b) decrease
    c) stay the same
    d) increase slightly, then even out

3. What is the density of a material that has a mass of 27.0 g and a volume of 9.0 cm^3?
    a) 0.33 g/cm^3
    b) 243.0 g/cm^3
    c) 36.0 g/cm^3
    d) 3.0 g/cm^3

4. If you used the theory of plate tectonics to predict the most likely place for the next earthquake or volcanic eruption, you should predict that it is most likely to occur:
    a) Along boundaries between colliding lithospheric plates.
    b) Where one has not happened in at least 10 million years.
    c) In the interior of any continent.
    d) Where a continental lithospheric plate is being subducted beneath an oceanic lithospheric plate.

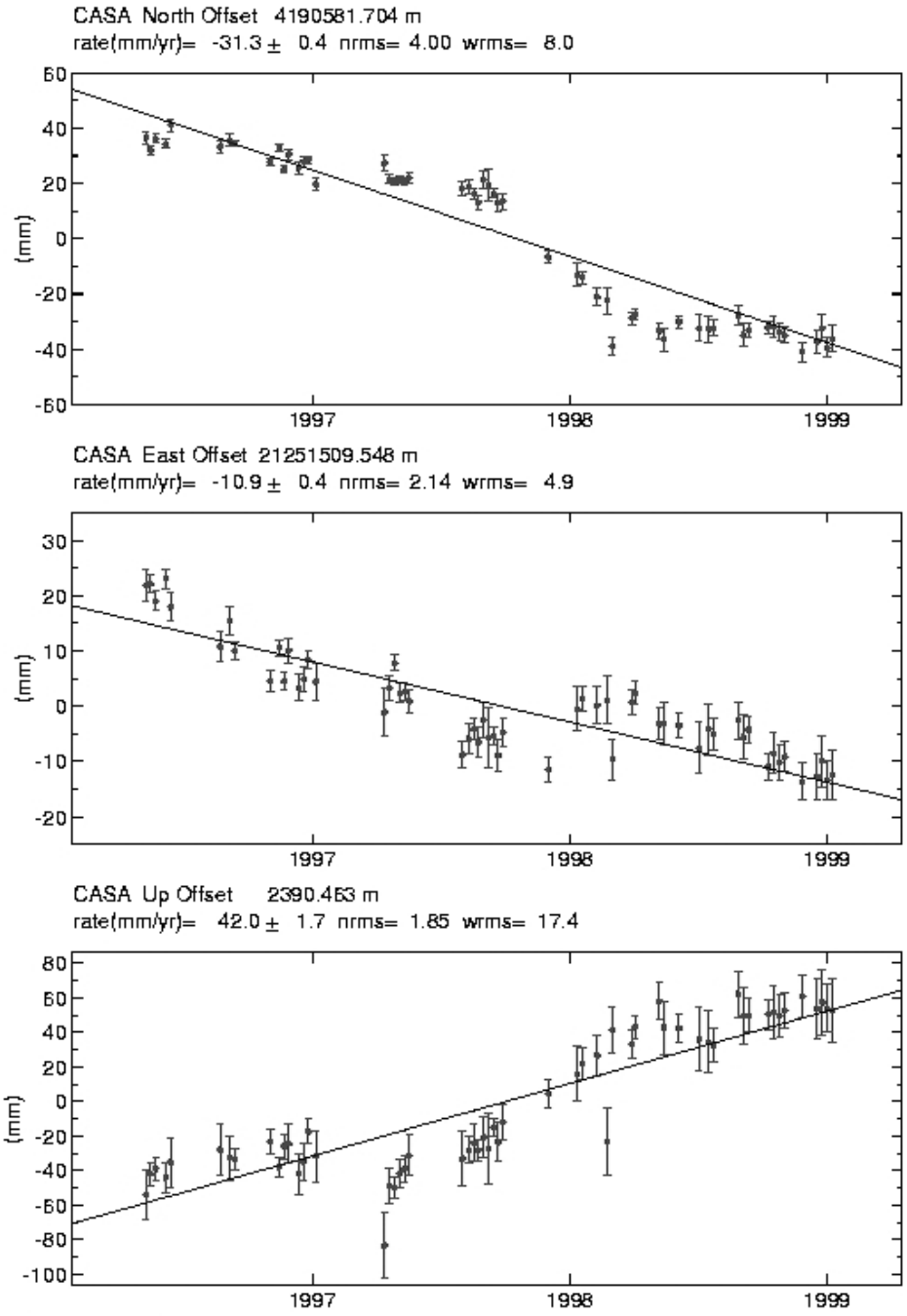
5. The theory of continental drift did not adequately account for which of the following?
    a) Why similar rock types were found on continents separated by oceans.
    b) Why similar fossils were found on continents separated by oceans.
    c) Why continents drifted across the Earth's surface.
    d) Why the coastlines of some continents appeared to fit together.

Label the schematic diagram showing the layered structure of the Earth.



10. What event is most likely to occur when an oceanic lithospheric plate collides with a continental lithospheric plate?
    a) The oceanic lithospheric plate will be subducted.
    b) The continental lithospheric plate will be subducted.
    c) A rift valley will form in the continental lithospheric plate.
    d) A hot spot will form in the oceanic lithospheric plate.

Use the GPS time series data for GPS recording station CASA in California to answer questions 11 – 13.



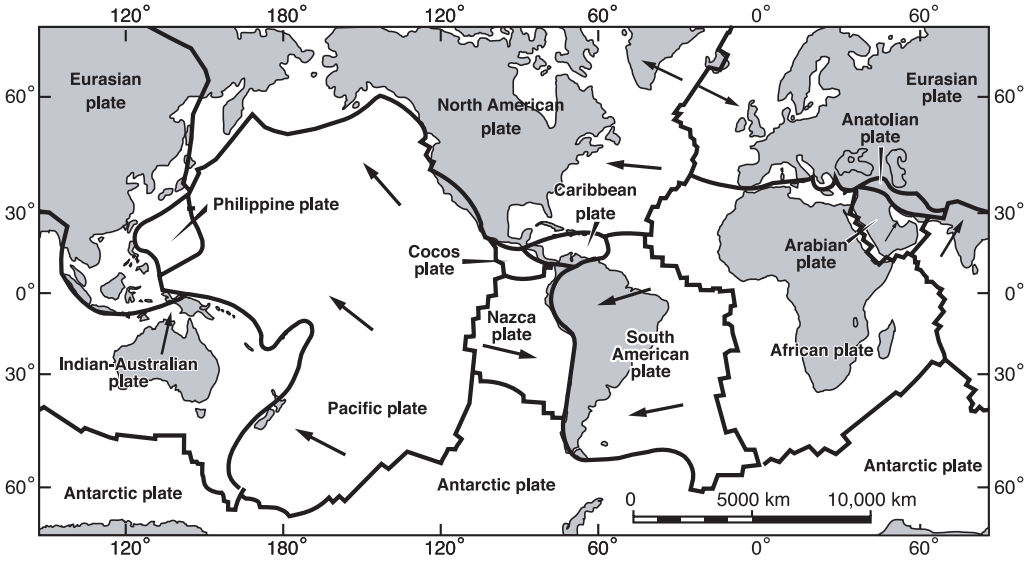
11. The top graph indicates that station CASA moved at a speed of:
    a) 10.9 ± 0.4 mm/yr West
    b) 31.3 ± 0.4 mm/yr East
    c) 31.3 ± 0.4 mm/yr North
    d) 31.3 ± 0.4 mm/yr South

12. The elevation of station CASA during the recording period has _____.
    a) increased
    b) decreased
    c) not changed

13. The middle graph indicates that station CASA moved at a rate of:
    a) 31.3 ± 0.4 mm/yr North
    b) 10.9 ± 0.4 mm/yr East
    c) 10.9 ± 0.4 mm/yr West
    d) 10.9 ± 0.4 mm/yr South

14. What is the name of the supercontinent that existed 250 million years ago?
    a) Gondwanaland
    b) Pangea
    c) Laurasia
    d) North America

Use the map below to answer questions 15 – 17:



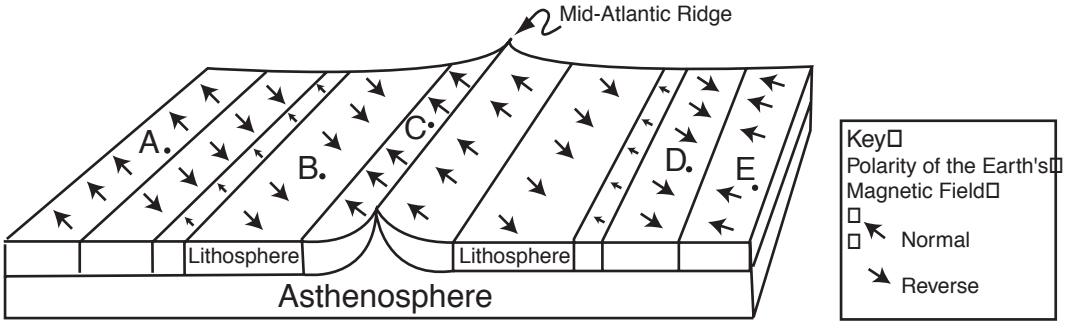
15. What type of geologic feature would you expect to find along the west coast of South America?
    a) A rift valley.
    b) A chain of volcanoes.
    c) An ocean ridge.
    d) A transform fault.

16. What is the east coast of the United States an example of?
    a) Divergent continental margin.
    b) Convergent plate boundary.
    c) Transform plate boundary.
    d) Passive continental margin.

17. At which of these boundaries would you expect to find oceanic lithosphere being created?
    a) Between the South American and Nazca plates.
    b) Between the Pacific and North American plates.
    c) Between the North American and Eurasian plates.

18. What has become the accepted primary mechanism for sea-floor spreading?
    a) Density differences in the crust.
    b) Convection cells within the Earth's mantle.
    c) The formation of magnetic striping along the sea floor.
    d) The tremendous weight of sea-floor sediments piled up over millions of years.

Base your answers to questions 19-21 on the diagram below. The diagram shows a portion of the Earth's oceanic crust in the vicinity of the mid-Atlantic ridge. The stripes in the diagram represent magnetic bands of igneous rock formed in the oceanic crust. The orientation of the Earth's magnetic field at the time of rock formation is shown by arrows within each band. Letters A, B, C, D, and E represent locations on the sea floor.



19. Heat flow measurements are made at locations A through E. Which graph best represents these measurements?
    a) A
    b) B
    c) C
    d) D

20. Rock samples taken from location B would most likely be composed of:
    a) granite
    b) rhyolite
    c) conglomerate
    d) basalt

21. Along a line drawn from location A to location E, the relative age of the oceanic crust would most likely:
    a) Decrease from A to C and increase from C to E.
    b) Increase from A to C and decrease from C to E.
    c) Decrease from A to E.
    d) Increase from A to E.

22. What do mid-ocean ridges and hot spots beneath ocean plates have in common?
    a) Both have rising magma due to density differences.
    b) Both are located along crustal plate boundaries.
    c) Both have local earthquakes that originate at great depths.
    d) Neither is associated with plate motions.

Plate Tectonics and Your Community: End-of-Chapter Assessment Answers

Answer Key

1. b
2. b
3. d
4. a
5. c
6. crust
7. mantle
8. outer core
9. inner core
10. a
11. d
12. a
13. c
14. b
15. b
16. d
17. c
18. b
19. c
20. d
21. a
22. a

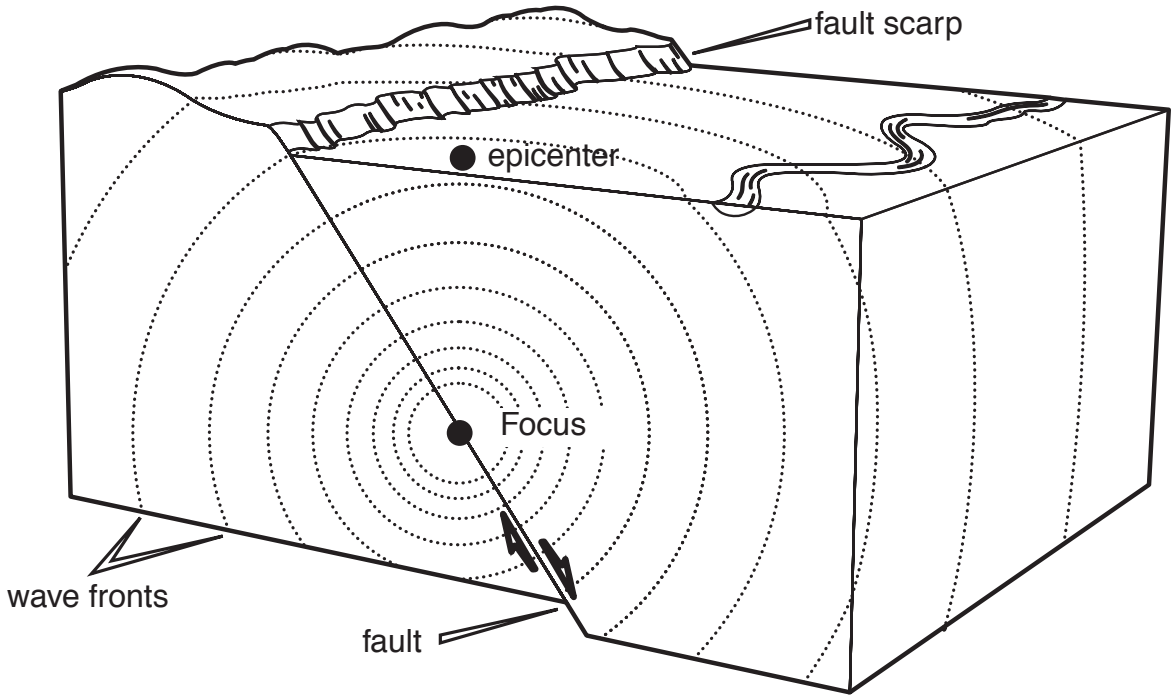
Plate Tectonics and Your Community: Classroom Resources

For a list of books, magazines, curriculum resources, web sites for teachers and students, videos, sources for materials listed in activities, and optional materials consult the *EarthComm* web site.

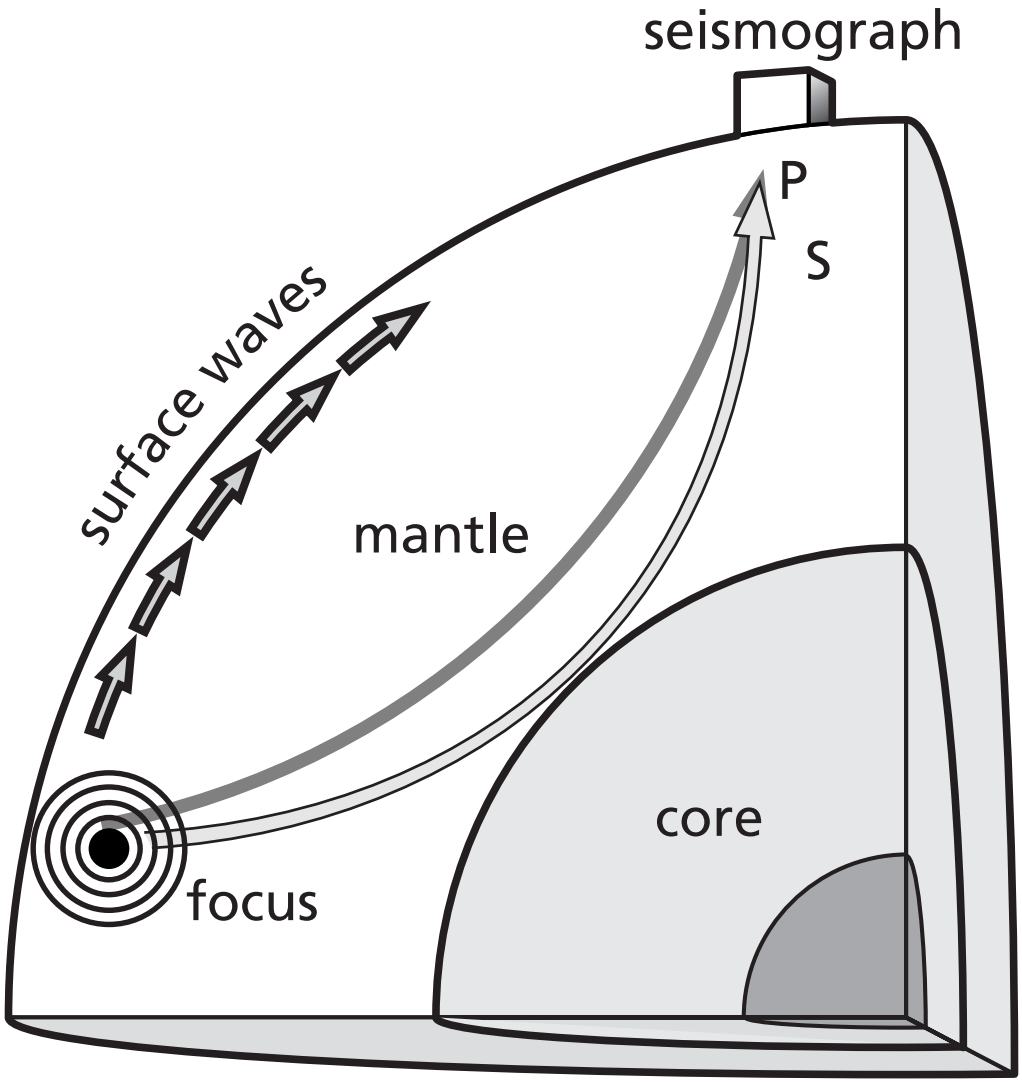
Earth's Dynamic Geosphere

Chapter 3
Earthquakes…and Your Community

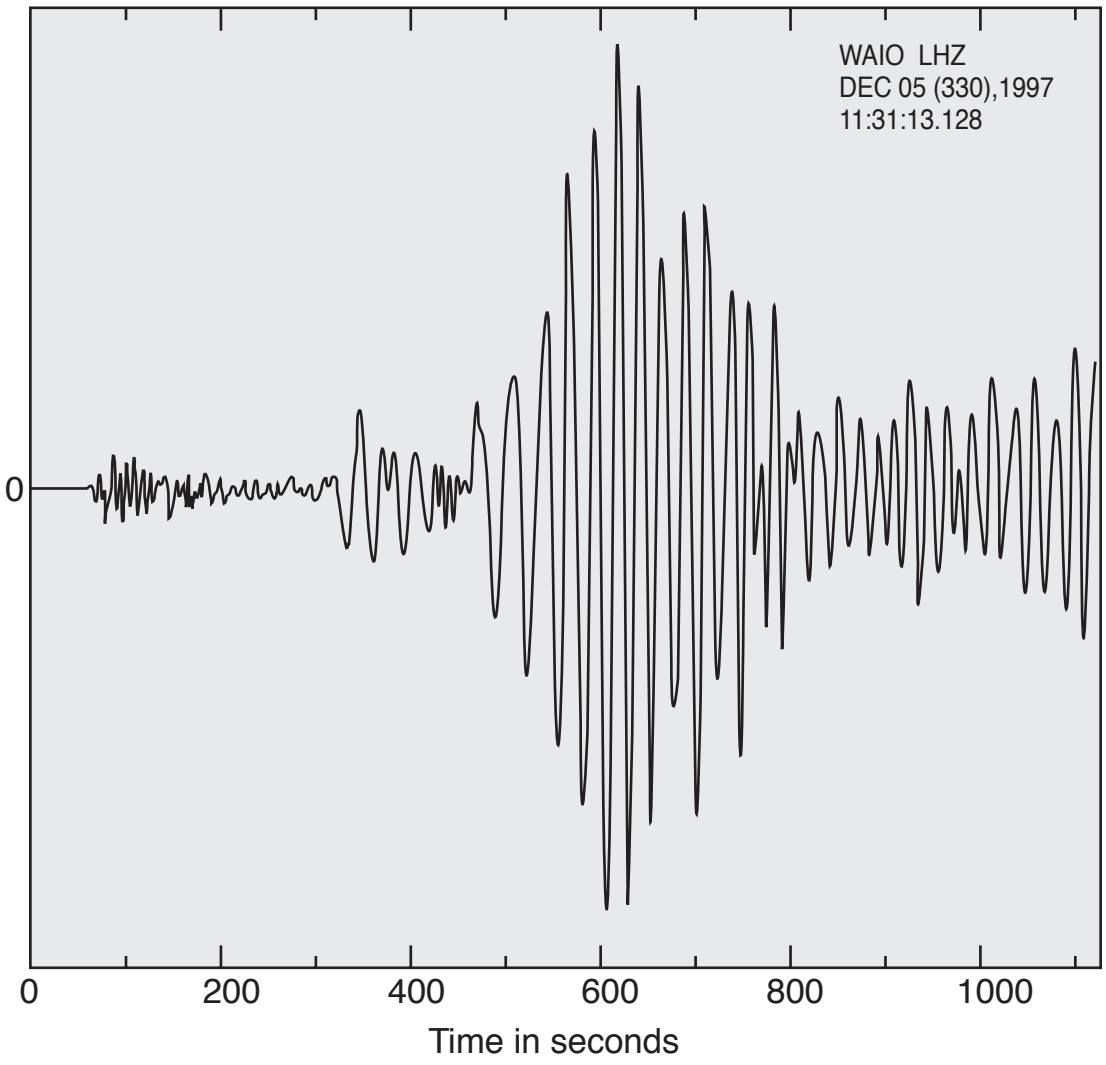
Blackline Master 1.1
Focus and Epicenter of an Earthquake



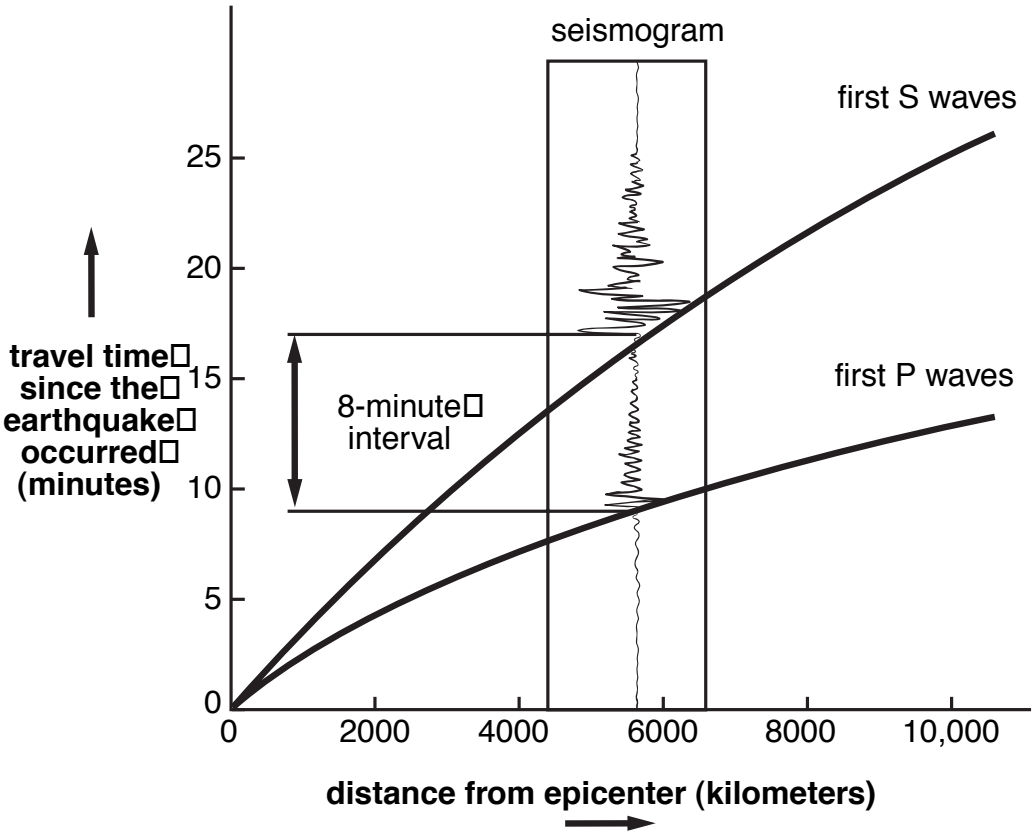
Blackline Master 1.2
Types of Seismic Waves



Blackline Master 2.1
Record of a Real Earthquake

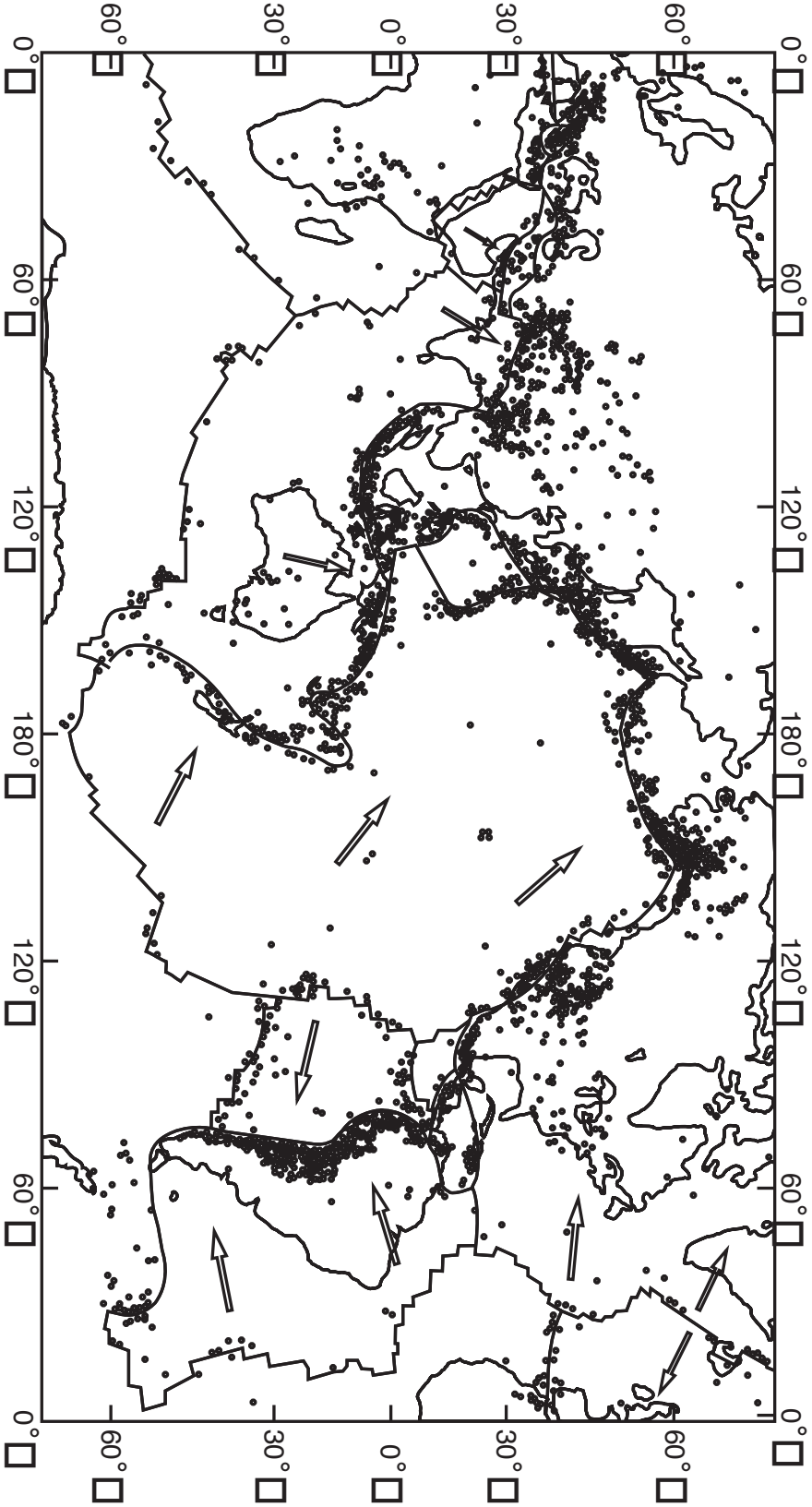


Blackline Master 2.2
Travel–time Curve for an Earthquake

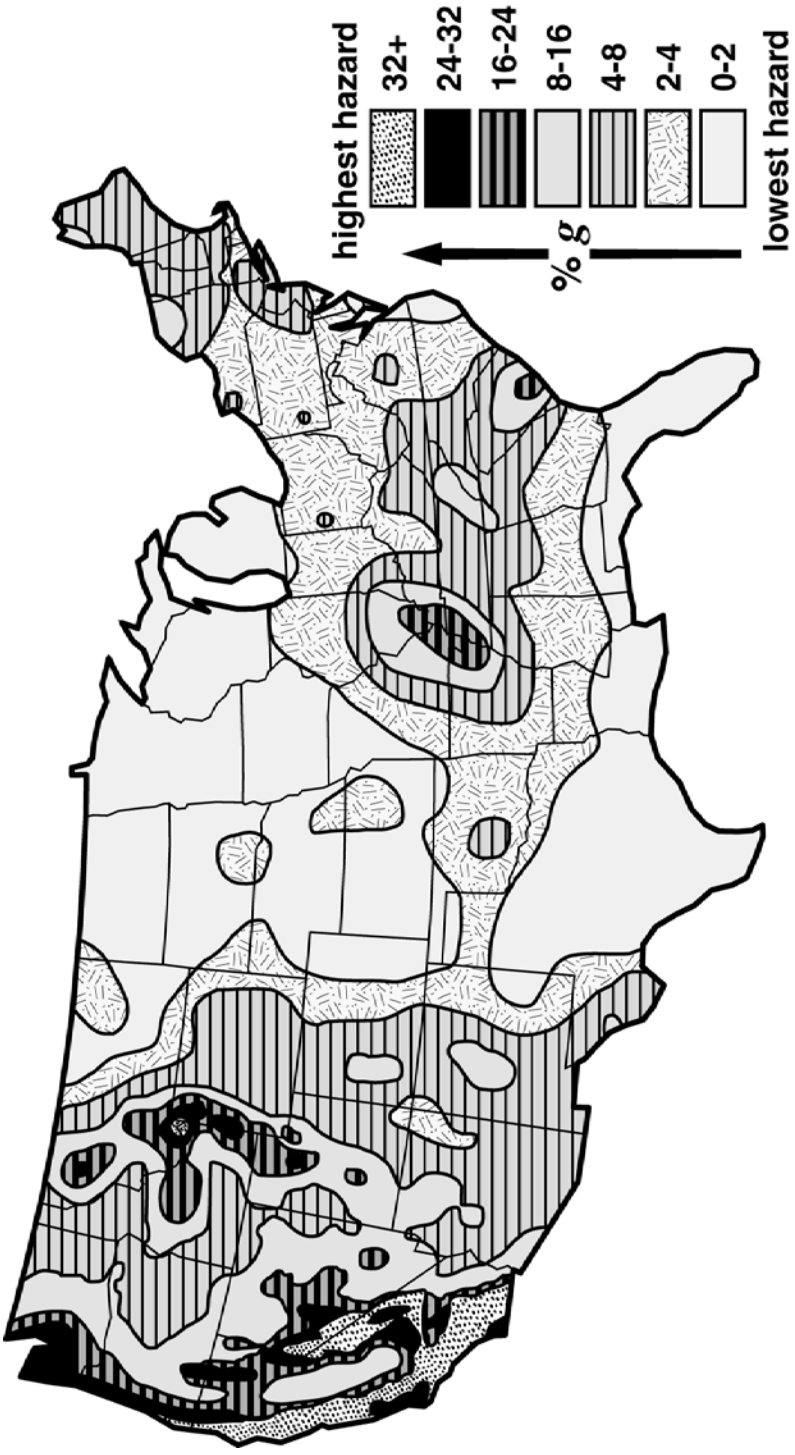


Blackline Master 3.1
Map of Eastern United States

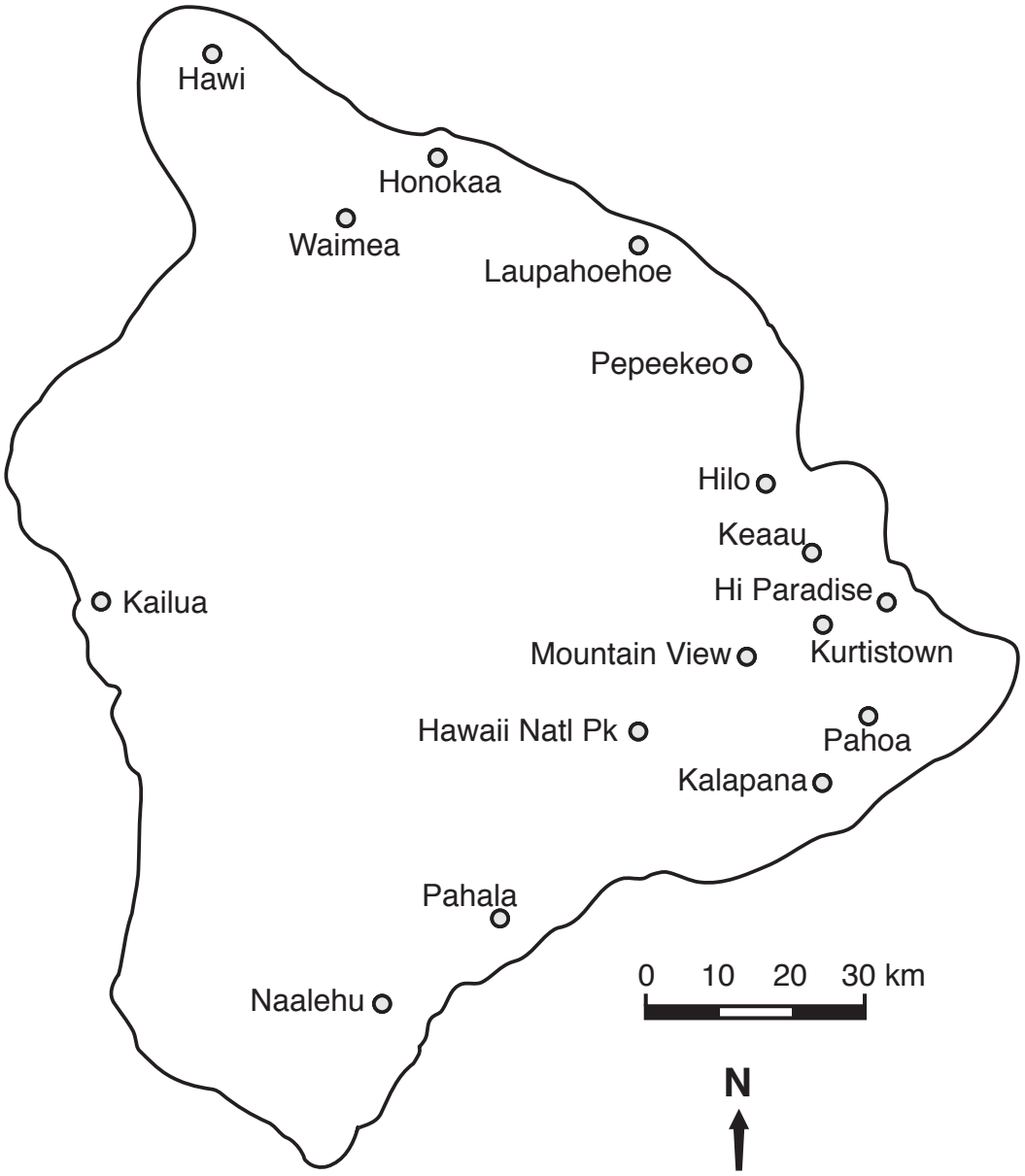
Blackline Master 4.1
Earthquakes



Blackline Master 4.2
Earthquake Risk for the United States



Blackline Master 5.1
Island of Hawaii



Earthquakes and Your Community: End-of-Chapter Assessment

1. A _____ is a fracture in rock along which rock masses move relative to one another parallel to the fracture.
    a) landslide
    b) focus
    c) seismogram
    d) fault

2. Walking to school one day you feel the ground move in an up-and-down rolling motion. You are experiencing a type of earthquake wave known as:
    a) Primary waves.
    b) Secondary waves.
    c) Surface waves.
    d) Breaking waves.

3. The point within the Earth where rupture first occurs to cause an earthquake is called the _____.
    a) origin
    b) focus
    c) epicenter
    d) rupture spot

4. Earthquake intensity is a measure of:
    a) The arrival time of an earthquake at a location.
    b) The size of the largest earthquake wave.
    c) The depth of the earthquake below the surface.
    d) The effects of an earthquake on the Earth's surface.

5. The Richter Scale is a measure of:
    a) The amplitude of seismic waves.
    b) The arrival time of primary waves.
    c) The people's reaction during an earthquake.
    d) The severity of building damage during an earthquake.

6. Seismologists pinpoint the exact location of an earthquake by:
    a) Interpreting seismograms from at least three stations.
    b) Surveying damage in the city nearest the earthquake.
    c) Measuring the sizes of earthquake waves.
    d) Looking for a fresh crack or break in rock or streets.

7. Which of the following states has the highest hazard for earthquake risk?
    a) California.
    b) Florida.
    c) Maine.
    d) Nebraska.

8. A tsunami is a great sea wave produced by:
   a) The collapse of large icebergs in the ocean.
   b) The pull of the Sun on the Earth.
   c) The pull of the Moon on the Earth.
   d) A submarine earthquake or volcanic eruption.

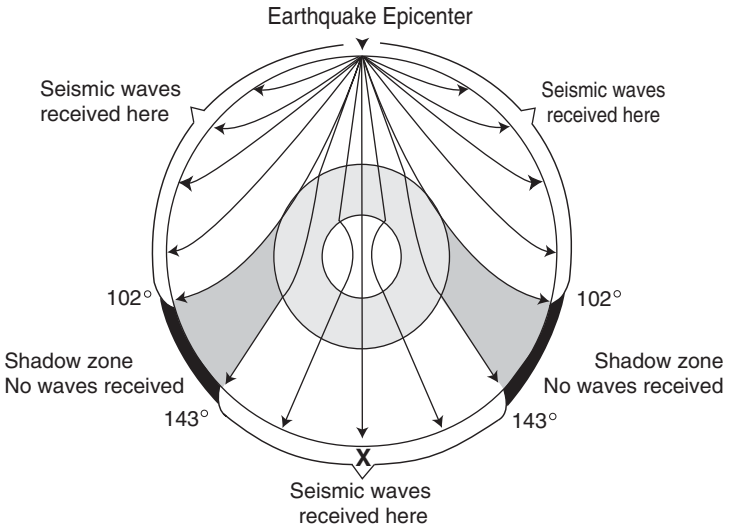
9. Which one of these buildings is likely to suffer the least amount of damage during an earthquake?
   a) A steel-framed building constructed on loose, wet soil.
   b) A brick or masonry building constructed on loose, wet soil.
   c) A brick or masonry building constructed on solid bedrock.
   d) A steel-framed building constructed on solid bedrock.

10. What kind of seismic waves can travel only through solids?
   a) Curved waves.
   b) Surface waves.
   c) Compressional waves.
   d) Shear waves.

11. The amplitude of seismic waves created by an earthquake with a Richter magnitude 9.0 is how many times greater than a magnitude 7.0 earthquake?
   a) 2
   b) 1000
   c) 100
   d) 2500

12. What causes an earthquake?
   a) The sudden release of slowly accumulated strain.
   b) The pull of the Moon and Sun on the Earth's crust.
   c) The swelling of the Earth's mantle.
   d) The expansion of the Earth's core.

The cross section of the Earth below shows the paths of seismic waves from an earthquake. Letter X represents the location of a seismic station.

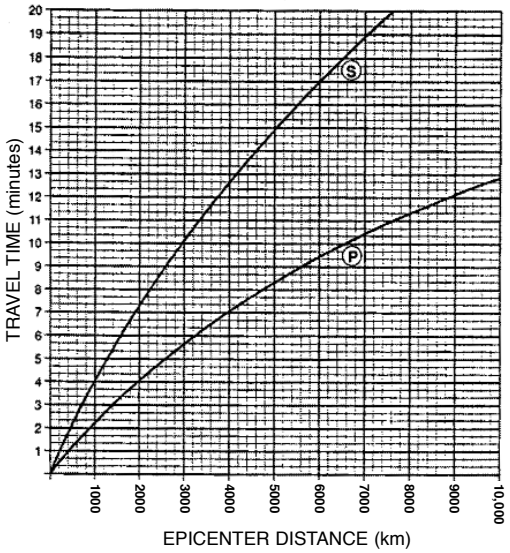


13. Which statement best explains why station X did not receive S waves generated by the earthquake?
    a) S waves traveled too slowly for seismographs to detect them.
    b) Station X is too far from the focus for S waves to reach.
    c) A liquid zone within the Earth does not transmit S waves.
    d) The earthquake did not generate any S waves.

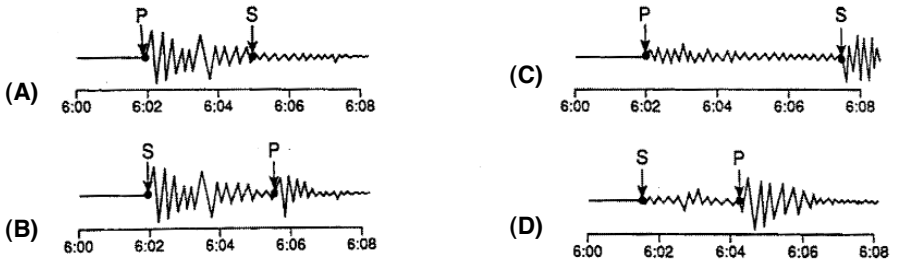
Base your answers to questions 14 and 15 on the table and the graph of P and S wave travel time shown below. The table shows some of the data collected at two seismic stations, A and B. Some data have been omitted.

Earthquake P-wave and S-wave Travel Time

Station	Arrival Time of P Wave	Arrival Time of S Wave	Difference in Arrival Times of P and S Waves	Distance to Epicenter
A	6:02:00 p.m.	6:07:30 p.m.	5 min 30 sec	— km
B	— p.m.	6:11:20 p.m.	7 min 20 sec	5700 km

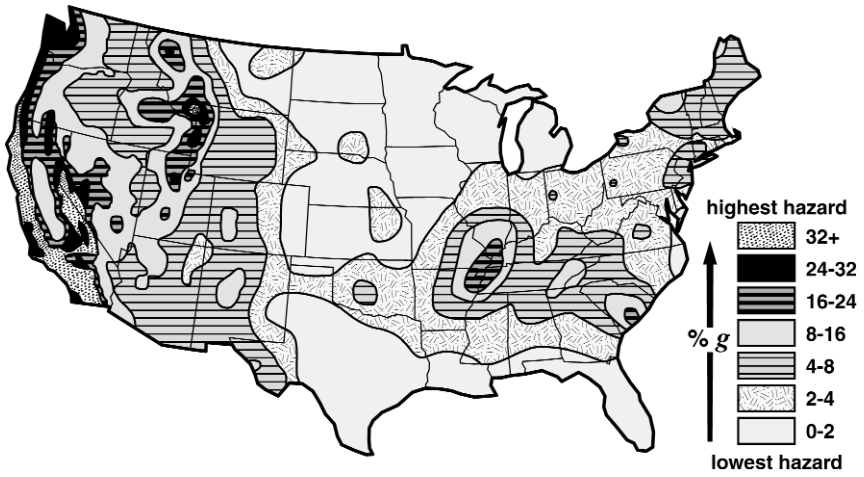


14. Which seismogram most accurately represents the arrival of the P and S waves at station A?
    a) A
    b) B
    c) C
    d) D



15. What is the approximate distance from the earthquake epicenter to station A?
    a) 1400 km.
    b) 1900 km.
    c) 3000 km.
    d) 4000 km.

16. The map below shows the earthquake risk for the United States. Which of the following explains why areas in southeast Missouri and coastal South Carolina are at such high risk?
    a) There are very frequent, large earthquakes at these locations.
    b) Missouri and South Carolina lie along boundaries of crustal plates.
    c) There has been earthquake activity recorded at these locations in the past.
    d) An earthquake has never occurred at these locations but statistically they are due one.



17. Two different cities experience an earthquake with a magnitude of 5.5 on the Richter Scale. However, on the Modified Mercalli Intensity Scale, the earthquake was rated V in one city and VII in the other city. What is the best explanation for this difference?
    a) One city is built on bedrock while the other is built on loose sediments.
    b) One city is nearer the Equator, the other is near a pole.
    c) The earthquake in one city occurred at 8 PM and the other occurred at 4 AM.
    d) One city is in a drier climate zone than the other.

18. If you were planning to develop land along an active fault zone, which type of development would be LEAST affected by the geologic hazards of the site?
    a) Single-family homes.
    b) Parkland for a golf course.
    c) An apartment or condominium complex.
    d) A mall shopping center.

Earthquakes and Your Community: End-of-Chapter Assessment Answers

Answer Key

1. d
2. c
3. b
4. d
5. a
6. a
7. a
8. d
9. c
10. d
11. c
12. a
13. c
14. c
15. d
16. c
17. a
18. b

Earthquakes and Your Community: Classroom Resources

For a list of books, magazines, curriculum resources, web sites for teachers and students, videos, sources for materials listed in activities and optional materials consult the *EarthComm* web site.